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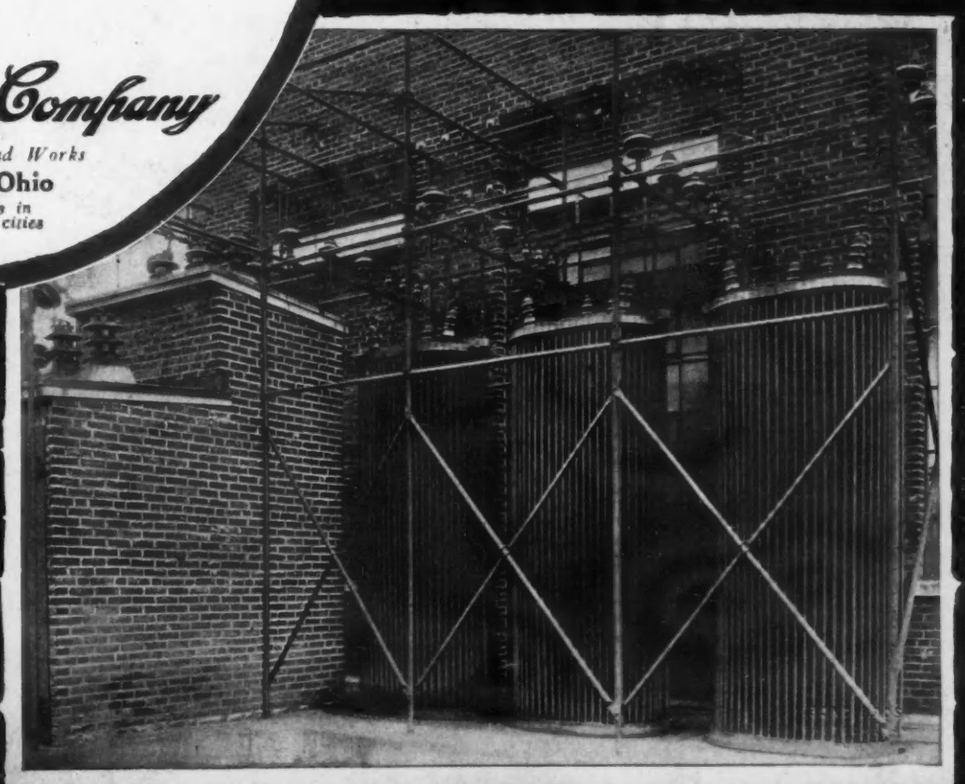

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Peace and Harmony Necessary in Iowa

WOE! Woe! Woe! Just as we were about to congratulate the industry on the increasing manifestations of harmony within and good will without, Iowa throws on an overload which blows a fuse. The contractors and central stations there are at sixes and sevens over Governor Kendall's veto of the Springer bill, the utilities charging the contractors with treason. The bill, which bore the indorsement of all water, gas, electric and railway companies of Iowa, had already passed both houses of the Legislature. It provided for a "court of public service" composed of three judges from the district courts of the state to pass judgment on the rates for service fixed by municipalities in cases where appeal to such court was made. Why the contractors should have opposed the measure is not apparent, since the bill did not involve them in any way, and naturally a merry war is in prospect unless saner counsels intervene and prevail. On the foolishness of strife within the industry it is needless to write. Neither do we purpose to hold a post-mortem on the result. What we do insist on, however, is that the contractors and electric light and power interests of Iowa compose their differences quickly and in an amicable manner. There can be no progress in an industry which is divided against itself and which is at the same time partly incapacitated through bickering and strife.

Government Help for Business

THERE is a manifest desire on the part of the government to join hands with business. Heretofore the manufacturer, if he had nothing to fear, attributed his immunity to his honesty rather than to any disposition on the part of Washington to let him alone, and as for expecting assistance from that quarter—he was not given to idle dreams. Now, however, all this is to be changed. The road will still be hard for the crook and the sword of Damocles will still threaten corrupt practices, but the honest business man will find in the Department of Commerce a listening ear, a receptive mind and a helping hand. No attempt will be made to regulate—that is farthest from Secretary Hoover's thoughts. The desire is to encourage foreign and domestic business through the collection and interpretation of statistics, through proper standardization, the elimination of waste, and by means of study and research—in short, to do for the manufacturer what the United States Department of Agriculture now does for the farmer. This is one of the most encouraging signs that have come out of Washington for quite some time.

It Is Not Altogether the Fault of the Daily Press

IT IS a pity that the average newspaper editor knows so little about the central-station business; but it is not his fault. The subject has never been made interesting to him, and he has seldom been told what he ought to know in the way that makes news items. A forceful illustration of the benefits that automatically come from such an understanding and the sympathy that will result was reported in last week's issue, in the case of the San Francisco *Chronicle*. The *Chronicle* is featuring a series of articles showing how the California power shortage is holding back different kinds of business. To correct the situation, it is urging better rates to attract new capital for further hydro-electric development. Think how many interesting stories could and would be told if utility managers would help newspaper editors to see that support for the utilities is constructive service to the whole community. Such publicity would constitute a never-ending good-will campaign.

California's Proposed Hydro-Electric Commission

THE California Electrical Co-operative Campaign has a job cut out for it. In fact, the real test of the efficacy of such a league must soon be made. The state proposes to emulate the example of the Province of Ontario in Canada and establish a hydro-electric power commission. There is no question of the right of the State of California to do that; but the wisdom of such a move is doubtful, and the California Electrical Co-operative Campaign ought to have no difficulty in proving it. In the first place, California possesses no water power comparable to Niagara Falls, from which the Hydro-Electric Power Commission of Ontario receives its chief supply of electricity. At Niagara nature has provided a bountiful supply of water at all times—ten times more than is needed for power purposes. The continuity of this supply of water is assured by mammoth storage basins comprising Lakes Superior, Michigan, Huron and Erie. Moreover, there is a sheer drop at the escarpment at Niagara Falls of about 160 ft. For that reason none of the power companies has had to provide expensive reservoirs, dams, long flumes or even steam reserve stations. If there is a place anywhere where electricity can be generated cheaply, that place is Niagara Falls; but there is no other place like it in the country. Under no circumstances, therefore, is it possible for California to duplicate or even approach what is being done in the Province of Ontario. Existing utilities in California generate and sell electricity very cheaply. The average cost is less than that in any other state and the per capita use is greater. It cannot be claimed that the companies lack enterprise or that

the public is not served adequately, because California utilities are among the most progressive in existence and a larger percentage of people is served with electricity there than elsewhere, even in Canada. Moreover, the state receives in taxes from the electric light and power companies 7.5 per cent of their gross annual revenue. If, therefore, a thorough and impartial investigation were made, California would find it greatly to her disadvantage to embark on any state-owned system of electric generation and distribution, particularly in view of the praises which have recently been heaped on the Railroad Commission and the public utilities act by the Inman legislative committee. That committee, the preconceived ideas of whose members underwent a complete change as a result of its investigation, earnestly commended the public utilities act of the state to the continued favor of the people. It reported that the act has worked well and is working well today and recommended that it be strengthened rather than weakened. Compared with the Ontario system, it should not be hard to show that all that glitters is not gold.

"Engineering English" Should Mean Good English

REFERENCES to "engineering English" are found in the editorial columns of both the technical and the lay press, the term being sometimes used in derision and sometimes seriously as if to denote a kind of writing with rules and usages of its own differing from those that apply to the composition of men not engineers. The best way for technical writers to escape the derision is to disabuse their minds of any idea that they should or properly may adopt a distinctive phraseology or method of construction. Apart, of course, from the inevitable use of the established technical terms of their profession, they should employ, with proper discrimination, the ordinary words of the dictionary, and observe, without pedantry, the accepted rules of English—not of foreign—grammar. A specialized vocabulary has by long prescription come to be considered appropriate for baseball reports and stories of seafaring life, but the engineering writer has no need of one. In committing his ideas to paper he should shun the conversational idioms of his professional pursuits equally with the jargon of commerce, the slang of the workshop and the stark uniformity of the hardware catalog. As to catalogs, there are, of course, useful compositions that must necessarily partake of the character of an inventory, but even in these cases skillful handling and the relegation of details to tables and to the legends under illustrations can do much to dispel the curse of dullness.

Good English is good English, whether the topic be literature, history, politics or engineering. The laws of syntax do not vary with a change of profession. The rules of rhetoric remain the same. Debasement of the noble currency of our mother tongue is much to be deplored. It is true that a mathematical thesis does not lend itself to pathos or a treatise on technology to the play of wit. That only makes it the more necessary that the principle of order, which is the first law of composition as well as of Heaven, and the principle of clarity, which is the second, should pervade them. Descriptive engineering articles, on the other hand, permit a forcefulness of presentation, a vividness of statement, even an occasional flash of imagination or touch of fancy, that they all too seldom display. Frenchmen, to whom the art of expression seems a native gift, have probably best exemplified the possibilities that inhere in engineering as a field for literary skill. To most Englishmen engaged in technical pursuits, and in still greater degree perhaps to most Americans, their work itself is so absorbing, the pressure to excel in action so compelling, that they have no time to learn to write. Graceful historians of the engineering arts are therefore in the English-speaking nations neither born, like poets, nor made, like the purveyors of popular fiction. Hence the records of invention and material achievement seldom rise above the threadbare phraseology and commonplace method of a memorandum book, although the facts related may be as far as possible from the threadbare or the commonplace.

A few engineering writers of rounded intellectual development, fed in their youth perhaps on the great masters of English who nowadays have fallen into such lamentable neglect, have succeeded in informing the books and papers they have written with an interest more widespread than that merely which inheres in the subject matter, just as a few lawyers have made arguments and a few judges have handed down decisions so lucid in their language, so limpid in their construction, and so shot through with eloquence suppressed or soaring, that intricate causes have taken on a general interest which the routine verbiage of the courts could never have bestowed. Such lawyers are rare, and such engineers unfortunately are rarer still. It would doubtless be demanding too much from human talents to expect otherwise. Yet the wish may be pardoned that our technical colleges would so train their students in the practice of writing that no graduate could compose the paragraphs, crude or redundant in form, ambiguous or obscure in meaning, and freely sprinkled with solecisms, that in some minds have come to be meant by engineering English.

Definition of "Navigable Stream" Still Further Confused

A RATHER far-reaching decision governing the construction of power dams in navigable streams was rendered by the United States Supreme Court in the fight of the government to prevent the construction of a dam across the Desplaines River near Joliet, Ill. As reported elsewhere in this issue, the case is that against the Economy Light & Power Company, now controlled by the Public Service Company of Northern Illinois. The Supreme Court in affirming the decisions of the lower courts based its decision largely on the fact that the stream in its natural condition had been navigated by early French explorers, fur traders and settlers in canoes and other light craft. That the stream has not been so used for a century was held of no effect.

While the decision from a power-supply standpoint is not serious to the utility because the power problem has been met by the construction of other plants and the stream has since become a part of the lakes-to-the-Gulf deep-waterway project, the precedent established is extremely important as it seems to extend the meaning of the term "navigable" to a hitherto unthought-of degree. If the fact that a stream has been used by Indians or others for transportation by canoe or other light craft is to be considered as constituting navigability, a serious handicap is imposed upon the American public depending upon future power developments on the streams now under federal control.

International Continental Line Closely Follows American Practice

SOME details of what is the most striking example of high-tension work yet given in France are contained in the current issue. The system is really an international one, with its power station on the River Aar at Goesgen, Switzerland, and the transmission line running north along the border of Alsace and crossing the Vosges Mountains into the Moselle Valley, which it follows to Pouxeux, France. The final voltage of the system is to be 110,000, although, as often happens in our own country, the first rating is 70,000 volts. The equipment is designed for the higher pressure throughout. The line is unusual in Continental practice, being a steel-tower structure with spans up to more than 600 feet, such construction having been selected largely on the entirely correct theory that the insulators are the weak points of the transmission system and the fewer of them the better. The towers themselves are virtually 50 feet to the lowest cross-arm and are set on concrete foundations. Except at dead-ends or angles eight suspension units carry stranded copper cable nearly a half inch in diameter and with a cross-section of about 154,000 circ.mils. Where there are bends in the line a special strain tower of extra solidity is used.

The system, erected about two years ago, has been in successful operation and works in parallel with the steam power station of the Compagnie Lorraine d'Electricité, for the benefit of which the transmission itself was undertaken. Despite the difficulties of the situation —for the construction was started before the armistice —the work was finished in a year and is a fine example of efficient construction, following quite closely American precedents while embodying some interesting variations in design.

Oil Fuel and the Electrical Industry

ACCORDING to figures presented before the American Petroleum Institute, the world's demand for petroleum in the present year will run close to 700,000,000 barrels, of which the United States will produce some 70 per cent and will use an even larger proportion, since we import oil from Mexico to an amount which is likely this year to aggregate 120,000,000 barrels. It is perfectly certain that unless great changes for the better are made and the methods of production improved, the United States will not be able to maintain its present demand for oil without much aid from foreign fields, and these fields are being absorbed by foreign powers as a part of an intelligent and deliberate program of making some future provision for their own national needs. Under these conditions any considerable permanent amount of importation, if accomplished at all, can be accomplished only at high cost, resulting necessarily in increased price of fuel oil here.

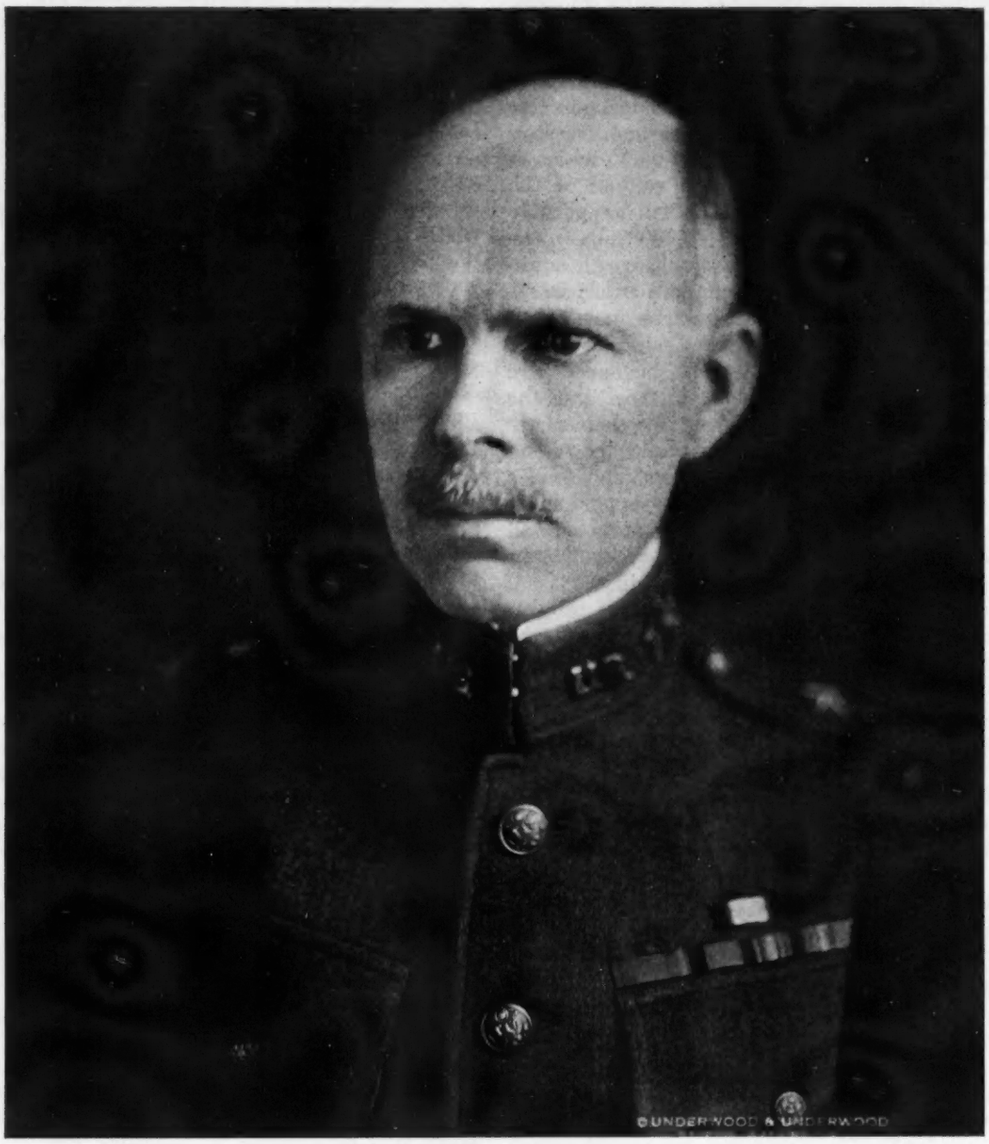
The vital question for public utilities depending upon steam generating stations in which plans are being made to use oil is whether the inevitable rise in oil prices will equal or surpass the relative rise in coal. Looking at the situation broadly, the country's coal supply appears to be considerably better from the standpoint of permanence than its oil supply, and considered merely as fuel to be burned under boilers oil appears to be a commodity which will become of dubious value if resorted to by any considerable proportion of the industry. The case is like a good many others in which certain operations are economically possible until the demand rises to serious magnitude, after which there is no saving to be had. Of course, some relief is possible where the Diesel or similar engines are used as prime movers on account of their higher thermodynamic efficiency in the production of power. Such engines are coming into large use for marine work, and operating as they do at fairly steady and nearly full load, their performance has been highly satisfactory.

Offhand, it would seem better, having regard to the general utilization of the world's fuel supply, to employ oil in marine service and for other purposes to which coal as such is not applicable. If there is to be anything like the increase in the use of motor vehicles which seems probable, there will be no considerable oil supply available for central stations. Here and there, as has repeatedly been shown in our columns, instances are encountered where local conditions render the use of oil fuel decidedly advantageous. Such cases will undoubtedly continue to exist even while the oil supply diminishes and demand for other purposes increases. In the main, however, and facing the petroleum situation as it is set forth by those most familiar with it, the conclusion is forced that unless the present situation changes for the better in a way now entirely unexpected the use of oil fuel in central stations, either under the boilers or in internal-combustion engines, will necessarily be of special and local, rather than general, application.

Power Factor and Adequate Rates

THE unusual interest now being shown in the definition of power factor is caused by a realization of existing inadequate rate schedules for power loads rather than by any desire for theoretical accuracy. Present-day conditions, which have made it necessary to analyze closely the costs of various kinds of service, have brought to light the advisability of reconsidering certain long-established customs. Power factor from a purely scientific point of view is and has been exactly defined. What is desired now is a practical definition of a concept based on power factor as a fundamental and which will not only have a definite meaning to both producer and consumer of electrical energy but will also be satisfactory as a basis for establishing rate schedules that will be acceptable to both parties. Moreover, it must also be possible to measure this quantity accurately, so that we must either adapt its definition to our present available meters or else develop new ones to meet the requirements. It is evident that accurate information is required regarding the cost of handling various kinds of power loads, and to obtain it considerable study will be necessary. Investigations from the customer's standpoint must also be made. Further, it must be realized that as our knowledge of these matters increases it is quite possible that any definition now adopted, unless its character is very general and its interpretation flexible, may need to be changed to meet new requirements.

The underlying fundamental that should be sought out is a rate for electrical energy whose application will result in the greatest possible economy or conservation from the standpoint of the people as a whole. Such a rate will naturally be satisfactory to both producer and consumer and can be arrived at only by thorough study of prevailing conditions. The problem is not one of theoretical physics, it is one of application of our present knowledge of equipment and costs to the best possible advantage of all.



George Owen Squier

A soldier-scientist and discoverer of the principle of "wired wireless" and numerous other developments in the art of communication who organized and directed the air and signal services of the American army during the war

THE old question about which branch of the service won the war will probably never be settled. It is true, however, that a war of such magnitude could be waged successfully only when the fighting forces were linked together by an unbroken communications system. It was to Gen. George O. Squier that the task was assigned of keeping this system intact and of perfecting it to meet new conditions. In the realm of science as applied to military activities he has won a high position.

A graduate of West Point, General Squier had all of the fundamental military traditions for a background. His first station at Baltimore enabled him to spend his hours off duty at Johns Hopkins University, where under such renowned scientists as Profs. Henry Rowland, Ira Remsen and Simon Newcomb the young officer laid the foundations for his later career as a physicist. There he secured the degree of doctor of philosophy in physical science and won for himself a fellowship. As a result of his researches, his first important contribution to science, entitled "Electrochemical Effects Due to Magnetism," was published in 1893. Four years later he began to apply physics to military science. From a series of experiments, some of which were conducted in conjunction with Dr. A. C. Crehore of Dartmouth, came a number of important results, among them being a new range and position finder and a synchronograph. The latter invention, which, based on the use of alternating current with the polarizing photochronograph as receiver, marked a great advance in the art of rapid transmission of intelligence, was but the beginning of a long series of improvements in telegraphy and telephony. None perhaps has received so much attention as the discovery of "wired wireless" announced by him in 1911. By means of selective sending and receiving his discovery made it possible to increase greatly the intelligence-carrying capacity of a cable. Although developed for military uses, it has also been applied commercially. His latest contribution to the art of communication was the discovery, announced less than a year ago, of the possibility of multiplex telephony and telegraphy over open-circuit bare wires laid in the earth or sea.

Naturally the General is a member of a number of the better-known scientific and engineering associations, including the Physical Society of London, of which he is a fellow. His polarizing photochronograph won for him the John Scott medal in 1896, his "wired wireless" discovery the Elliott Cresson medal award by Franklin Institute in 1912, and seven years later the Franklin medal was awarded to him by the same institution in recognition of his achievements not only in science but also his war success with the air and signal forces.

It was at Dryden, Mich., March 21, 1865, that General Squier was born.

Rating of Electrical Machinery

Standardization Rules of the American Institute of Electrical Engineers and the Electric Power Club Are Discussed to Compare the 40-Deg. Rated Motor with the 50-Deg. or Continuous-Rated Motor

By FRANCIS B. CROCKER*
Crocker-Wheeler Company, Ampere, N. J.

A SHARP difference of opinion has arisen in recent years regarding the merits of the 50-deg. rating of electric motors, and a fair statement of the case of the 40-deg. rated motor, which represents the attitude of some fifteen motor manufacturers in the United States, is offered in this article. This group adheres to the principle that a factor of safety is as necessary in electrical machinery as in other engineering apparatus. It is also its belief that the small saving in cost effected by the use of a lighter motor is not justified if the reliability of the plant, of which the motor drive is a part, is thereby decreased.

Early Standardization Work of the A. I. E. E.

The original A. I. E. E. Standardization Rules issued in 1899 and all revisions and editions of the same issued up to and including 1911 recommended for electrical "machines in general" a standard ambient temperature of 25 deg. C. and a maximum temperature rise of 50 deg. C. In other words, the maximum observable temperature should not exceed 75 deg. C. The present A. I. E. E. rules permit 50 deg. rise from a standard ambient temperature of 40 deg. C., that is, a maximum observable temperature of 90 deg. This is 15 deg. higher than that recommended in the previous A. I. E. E. rules, which were in existence for seventeen years and under which the electrical industry virtually grew up. "Hottest-spot" temperature and the "conventional allowance" for the difference between that value and the maximum observable temperature were not considered in the A. I. E. E. rules prior to 1916. Hence comparisons must be made of the observable temperatures. This is true today, because temperatures for "hottest spots" and "conventional allowance" are necessarily assumed for all except large or special machines with embedded detectors in their windings.

Before 1916 the A. I. E. E. rules recommended 25 per cent overload capacity for two hours, "with an additional temperature rise not exceeding 15 deg. C. above those specified for rated load." This applied to all direct-current and alternating-current generators and motors. The latter were also recommended to have an overload capacity of 50 per cent for one minute.

The A. I. E. E. rules of 1916 and since do not recommend any overload capacity whatever. Why and how was the maximum observable temperature raised from 75 deg. C. to 90 deg. C. and overload capacity wholly eliminated? The reasons and procedure are far from being clear or satisfactory. According to the published records what happened was as follows:

In 1912 the A. I. E. E. standards committee began to prepare a revision of its rules, especially as to rating of electrical machinery. The midwinter convention in February, 1913, was held under the auspices of the standards committee, and forty-five papers were presented, all relating to this subject. The first two papers, on "Temperature and Electrical Insulation," by C. P. Steinmetz and B. G. Lamme (sub-committee on revision of rules), and "Method of Rating Electrical Apparatus," by W. L. Merrill, W. H. Powell and Charles Robbins (sub-committee on rating), were particularly prominent, being presented by sub-committees of the standards committee and intended to give a basis for the revision of the rules. They are still supposed to be the authority on which the rules were changed as to temperature rise and overload capacity.

Classic Work of Steinmetz and Lamme

Unfortunately these papers have acquired a meaning not at all justified. The Steinmetz and Lamme paper (*Transactions A. I. E. E.*, Vol. XXXII, page 81, April, 1913), referring to fibrous insulation materials such as cotton, silk and paper, treated or impregnated, as ordinarily used in electrical machines, states:

> In Class A the materials appear to have a very long life (or an almost indefinitely long life, aside from mechanical conditions) if subjected to ultimate temperatures which never exceed 90 deg. C. Also they appear to have a comparatively long life even at ultimate temperatures as high as 100 deg. C.

Certainly this statement is no warrant for going beyond this limit, which the A. I. E. E. rules do by permitting 105 deg. C. for Class A insulation. Moreover, Fig. 1 of this A. I. E. E. paper indicates that the life is shortened to about four years at 105 deg. C. Still more significant is Mr. Lamme's statement on page 77, that "this would bring the temperature up to 105 deg. C. on my assumptions, which would be right on the ragged edge."

The Steinmetz and Lamme paper, under "Recommendations," also states:

> That with Class A insulation 90 deg. C. be taken as the ultimate temperature limit, as indicated by conventional methods of measurement, or those which give similar results, and that 100 deg. C. be considered as the maximum ultimate temperature permissible in the insulation, where a comparatively long life is a requirement.

In discussing his paper, Dr. Steinmetz says:

> The room temperature must be limited to a certain maximum of 40 deg. and the maximum insulation temperature must be limited to a definite value, 100 deg. (*Transactions A. I. E. E.*, February, 1913, page 117).

The Steinmetz and Lamme paper is therefore a *warning* not to venture above 100 deg. even in "hottest

*Professor Crocker was chairman of the original standardization Committee of the American Institute of Electrical Engineers, being appointed in 1898 and continuing for about ten years thereafter. He was the A. I. E. E. representative and chairman of the committee of the "conference of electrical, insurance, architectural and allied interests" that formulated the first National Electrical Code in 1897. Dr. C. O. Mailloux and he were the two American delegates to the meeting held in London in 1906 which created the International Electrotechnical Commission. He was president of the Electric Power Club in 1913 and 1914. Since 1886, associated with Dr. S. S. Wheeler he has been continuously engaged in manufacturing electrical machinery.

spots," because surely we should not go even near "the ragged edge." Though often forgotten, it is a fact that a 105-deg. C. permissible temperature will often be exceeded in practical use by variations in voltage, current, frequency, speed and power, as well as by inaccuracies of commercial instruments, peculiarities of individual machines, etc. All of these are inherent in practice, especially with the widely different and often very unfavorable conditions under which electrical machines operate. Indeed, reasonable departures from normal voltage, current, etc., are expressly permitted in practice by the rules of the Electric Power Club and other such codes.

The paper on "Method of Rating Electrical Apparatus," by W. L. Merrill, W. H. Powell and Charles Robbins (sub-committee on rating), contains the following recommendation:

Ultimate Temperature—Cotton, treated cloth, paper and similar substances which may fall in this general classification, maximum ultimate temperature of 90 deg. C.

Evidently, in this case, the 90 deg. C. means the temperature observed by thermometer and apparently justifies a rise of 50 deg. from the 40-deg. room temperature. On the other hand, this paper, as well as that of Steinmetz and Lamme, assumes a "hottest-spot" temperature 10 deg. and not 15 deg. higher than that observed by thermometer, according to the present A. I. E. E. rules. As already pointed out, the words "a maximum ultimate temperature of 90 deg. C." allow nothing for inevitable variations of voltage, frequency, etc. These two papers embody strong arguments against allowing 105 deg. C. as the ultimate "hottest-spot" temperature, because margin surely should be allowed for such variations of current and other working conditions.

Motors Should Have Factor of Safety

Why have these two papers been taken as a basis for permitting 105 deg. C. maximum temperature? Mr. Lamme says this is "right on the ragged edge," with no allowance whatever even for inevitable variations in current supply, etc., and therefore has a minus factor of safety. In all engineering this is the only example of not relying upon our good and tried old friend—factor of safety. The need of it for electrical machinery is as great as for any other kind of machinery. Indeed, it is greater, because heat is generated and stresses are produced by electric and magnetic actions as well as by mechanical, and we have the very uncertain and easily affected matter of insulation.

The Electric Power Club discussed the question of 50-deg. rating at several meetings. Finally, at its meeting of May, 1916, the 50-deg. rating was added as a "recognized departure" (*Bulletin No. 110*, May, 1916, pages 158-9):

1. There may be two ratings for open-type motors and generators with Class A insulation and continuous time ratings, as follows:

(a) A rating giving a 40-deg. temperature rise guarantee under continuous operation with a two-hour 25 per cent overload guarantee at 55 deg. to be designated and known as the 40-deg. rating.

(b) A rating giving a 50-deg. temperature rise guarantee under continuous operation without overload temperature guarantee, to be designated and known as the 50-deg. rating.

2. Machines having 40-deg. ratings are designed for all classes of service, including those in which an overload capacity of 25 per cent for two hours is desired.

3. Machines having 50-deg. ratings are designed for all conditions in which the load requirements are accurately known and under which the motor will not be subjected to load in excess of its rating.

A 50-deg. open-type continuous-duty motor for general purposes as distinguished from a 50-deg. special application motor as described in the above rules is a recognized departure from the standards of the Electric Power Club.

The above statements in the "Handbook of the Electric Power Club" (August, 1920, page 65) are cautionary and not at all reassuring as to 50-deg. general-purpose motors. Evidently we should be very careful in choosing and using such a machine.

A book on "Management of Electrical Machinery," by F. B. Crocker and S. S. Wheeler, the first edition of which appeared in 1892, contains on page 8 the following statements:

Weight: It is a mistake to select a very light machine when it is for stationary use because weight increases strength, stability and durability.

Cost: It is usually an error to select a generator or motor simply because it is cheap, both the materials and workmanship required for the construction of a high-grade electrical machine being costly.

It is a fact, therefore, that twenty-nine years ago Dr. Wheeler and the writer both firmly believed and clearly stated that ample weight in a machine increases its "strength, stability and durability"; also that "it is usually an error to select a generator or motor simply because it is cheap."

Objections to Lighter Motors

The chief characteristics of the 50-deg. machine are lightness and cheapness; indeed, it is not even claimed that it has any other advantage. Its higher temperature limit is a serious defect because it puts the machine "right on the ragged edge."

In the discussion of the papers by Steinmetz and Lamme and by Merrill, Powell and Robbins, Dr. Wheeler began his remarks as follows:

"My interest in keeping up or, if possible, raising the standards for apparatus in this country is so great that I am impelled to say a word or two."

He also said that:

"Electrical apparatus needs plenty of margin or the adherence to a high standard; it is delicate and liable, unlike almost any other kind of apparatus, to approach the breaking point without the fact being visible to the user.

"I think it is very important to keep up the margins or factors of safety."

In the discussion of these papers the writer said:

"Any machine built in accordance with maximum rating must be applied to its work much more carefully than at present. Since it cannot carry any overload it must never be overloaded, and therefore an intimate knowledge of the conditions under which a machine will have to operate during its whole life must be obtained. Even the most careful investigations can only go far enough to apply a motor properly in the first place, but they do not take care of future conditions."

This statement, made three years before the action of the Electric Power Club already quoted, exactly agrees with it and calls attention to what must always be a risky point in the general use of maximum-rated machinery. The writer also said:

"The proposed rating not only fails to provide any margin or factor of safety whatever, but permits insulation to be used at a temperature at which it admit-

tedly suffers permanent and considerable depreciation. Hence the margin is actually a negative quantity.

"It is a violation of the fundamental principles of engineering and nothing short of foolhardy for electrical engineers to attempt to get along without factors of safety."

When the Electric Power Club in May, 1916, added the 50-deg. general-purpose motor as a "recognized departure" from its standards, the Crocker-Wheeler Company made the following statement:

> The Crocker-Wheeler Company wishes to be recorded as acquiescing in, but not approving, this resolution, in so far as it permits a motor that heats to 50 deg. under rated load to be called standard. Such a motor has no reserve for overload or for unfavorable variations in the current supply and is therefore liable to develop trouble and consequently affect the confidence of the public in the reliability of electrical apparatus. (*E. P. C. Bulletin No. 110*, May, 1916, page 159.)

This action was taken as a matter of courtesy on its part because a unanimous vote is required by an unwritten but unbroken Electric Power Club law. Many other member companies disapproved the 50-deg. rating for general purpose-motors but voted for it, not wanting to prevent some companies from using it since they were anxious to do. The disapproval of the Crocker-Wheeler Company was so strong that it recorded the fact in the minutes. The numerous objections to the 50-deg. rating were recently stated by A. C. Bunker,* chief engineer Crocker-Wheeler Company, and are based upon long, varied, intimate experience in designing, installing and operating electrical machinery.

On these four important occasions, twenty-nine years ago, eight years ago, five years ago and one year ago, also at many other times, the Crocker-Wheeler Company strongly opposed lowering the standard for electrical machinery. In the past it has never seen and it does not now see any good reason for changing its attitude.

Confusion and Misuse of Terms

The rating of electrical machinery has been complicated because various names have been used and often misapplied. "Continuous rated" has been appropriated to mean a 50-deg. motor. On the contrary, a 40-deg. machine will run longer and therefore *more continuously*. Hence it is most misleading to distinguish 50-deg. motors as continuous-rated. The word "continuous" should be used only in contradistinction to "short-time," "intermittent," etc., but not to signify a particular temperature rise nor absence of overload capacity.

A 50-deg. machine is maximum-rated. Indeed, its temperature exceeds the limit set by Steinmetz, Lamme, Merrill, Powell and Robbins in their papers. Hence it is over-maximum-rated. Hereafter a spade should be called a spade and not disguised by euphemism.

The term "single rating" has also been identified with the 50-deg. machine. It is single-rated because it has no overload capacity. Any machine, however, is single-rated if only one load or temperature rise is guaranteed. In this case also maximum rating should be designated as such and not camouflaged by terms that do not apply to it any more than to other quite different kinds of machines.

The point often urged that single rating is *simpler* than one including overload capacity is not in itself sufficient reason for adopting it. A single commandment would be simpler than ten commandments. It is far more important to have machines dependable under practical working conditions than it is to have them simply rated.

The most unfortunate confusion of terms is found in the A. I. E. E. Standardization Rules. Under "Temperature Limits" the following statement is made: "Table III gives the limit for the 'hottest-spot' temperatures of insulation. The permissible limits are indicated in column 1 of the table." The title of Table IV is "Permissible Hottest-Spot Temperatures and Limiting Observable Temperature Rises." The word "permissible" should not be linked with "limit." They are really contradictory. From its very nature a *limit* should not be *permitted* in practical matters. For example, the edge of a precipice is a *limit* but should never be *permitted* for the ordinary human being. A reasonable margin is needed to take care of human imperfections—also material imperfections—because even an expert "steeplejack" would not be safe at the limit, as the edge of the precipice might crumble. Common sense demands such margins.

No less than three false steps have been taken in formulating and applying the A. I. E. E. Standardization Rules:

1. The difference between the hottest-spot temperature in the insulation and the maximum observable temperature by thermometer has somehow increased from 10 deg. in the Steinmetz and Lamme paper to 15 deg. in the present A. I. E. E. rules. This raises the permissible hottest-spot temperature from 100 deg., which Steinmetz and Lamme recommend, to 105 deg., which Mr. Lamme says is "right on the ragged edge."

2. An extreme *limit* of temperature is taken as a practical working point for general purposes. This is analogous to taking the breaking load of an elevator cable or the bursting pressure of a boiler as proper working points.

3. The *permissible* temperature limit is taken as *mandatory*. It is bad enough to assume that a limit is permissible, but far worse to interpret the rules to mean that we *must go the limit!* We often hear it said that "the A. I. E. E. rules require" us to allow 50 deg. observable temperature rise!

Real Status of 50-Deg. Rating and Elimination of Overload Capacity

On both sides of the Atlantic it often is asserted that disapproval of 50-deg. rating and of the elimination of overload capacity have already dwindled to insignificance. The opposition is said to be limited to a few conservatives who do not yet "see the error of their ways," but even they are rapidly being "enlightened." The facts are that a large majority of the companies manufacturing electrical machinery in the United States, England and Canada strongly disapprove of allowing 50-deg. temperature rise. At least fifteen American manufacturers are definitely opposed to adopting that change. Moreover, many, if not most, of the electric machinery manufacturers of England favor the retaining of overload capacity. The opposition is not insignificant, dwindling or benighted.

The physical facts, in the opinion of the writer, give no proper engineering basis for permitting the 50-deg. rating of electrical machinery. The data are questionable and seem to have been fallaciously interpreted or changed. It is alleged that improvement in materials and construction enables a machine to be designed

*Electrical World, Jan. 10, 1920.

more closely than was possible when the 40-deg. standard was adopted. The truth is, however, that Class A insulating materials have not been improved substantially and certainly not enough to warrant a 10-deg. increase in temperature rise.

It is virtually impossible to estimate load requirement, operating conditions as to current supply, etc., so closely as to warrant the adoption of maximum rating. Moreover, a 40-deg. motor need not be so carefully selected and therefore has a much wider field of application. Temperature is only one factor causing motor deterioration. Vibration, expansion and contraction, centrifugal force, moisture and other causes also shorten the life of the insulation of electrical machinery. This makes the need of margin all the greater.

Machines manufactured in quantity from the same specifications show differences of several degrees in temperature rise, even under same conditions of test. The 40-deg. rating allows for such individual peculiarities.

A so-called "modern" reason advanced for permitting 50-deg. rise is that now there are more well-trained men engaged in applying motors, so that better selection is made than in the past. This means that every time a motor is bought a well-trained man should be consulted. If there are spare motors, he must be consulted when one of them is applied or any change is made.

It is also said that maximum rating "puts the responsibility on the purchaser." Presumably he knows little about electrical machinery, certainly less than the manufacturer, yet he is expected to know his load requirements "accurately," because the manufacturer gives him no margin to cover conditions that he cannot possibly estimate so closely and that even an expert cannot prophesy.

On the testing bench of its manufacturer under very favorable conditions of attention, ventilation, exactly normal voltage, current, frequency, load, etc., a *new* 50-deg. motor rises that amount in temperature. Surely its temperature rise will be much greater when the machine is old, covered and clogged with dust and dirt, often with unfavorable operating conditions, including voltage above or frequency below normal, little or no attention, etc. The hottest-spot temperature is then likely far to exceed the limit of 100 deg. originally fixed by Steinmetz and Lamme. In these times we should not expect extra care in selecting, installing, operating and cleaning machinery. It is virtually impossible to hire such special care, and if it could be obtained, the extra cost would much more than wipe out any saving in purchase price of the machine.

Conclusions.—The price of the 40-deg. motor is from 10 to 25 per cent more than that of the 50-deg. motor of the same rated horsepower. In the average electrically driven plant the cost of the motors is usually only 2 or 3 per cent and rarely more than 5 or 6 per cent of the total cost of the plant. Hence about 25 per cent of 6 per cent, or 1½ per cent, is the very greatest probable saving. In most cases the saving in total cost of plant would be less than 1 per cent if 50-deg. motors are bought instead of 40-deg. motors. Would an electrical engineer spending his own money be willing to introduce even a question of unreliability into his plant simply to save less than 1 per cent of its cost? For that matter, would any business man make such a mistake—and it would be a mistake—if he knew the facts in the case? Would he have a thousand-dollar or two-thousand-dollar outfit "on the ragged edge" during its whole life simply to save $5, $10, or even much more, in first cost? Fixed charge is still more unfavorable to a 50-deg. machine. The average of many cases under very variable working conditions, the clogging up of ventilating ducts, and in general the extra care demanded by absence of safety factor of the 50-deg. motor, would involve much more expense in time, trouble, attention, repairs, etc., than the slight saving in interest on the investment. This interest and saving is at most only about 6 per cent less than one-sixteenth of 1 per cent on the money invested.

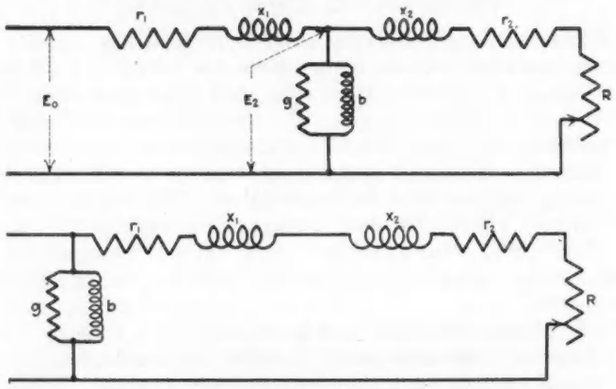
New Viewpoint on Induction Motor Diagram

Effect of Primary Impedance Is to Tilt Circle, but New Interpretation and Test Data Show that Tilting May Be Down as Well as Up

BY R. G. WARNER
Electrical Engineering Department, Yale University

PERHAPS no diagram has been used so widely for the interpretation of induction-motor performance as the circle diagram. Its use is not limited to designers, but electrical engineers in the industries often use it for installation tests and for occasionally checking the performance of motors in service. While the refinement of tilting the circle is not necessary except where accurate results are required, a complete understanding of the possibilities and limitations of the diagram should be of interest to electrical engineers.

In the usual refined treatment of the diagram a consideration of primary impedance has caused an upward tilting only of the circle. In the following development, however, the writer has found that the circle may tilt either up or down, depending on the relative values of the constants in the expression for the primary impedance. This downward tilting of



TOP, ACTUAL EQUIVALENT INDUCTION MOTOR CIRCUIT. LOWER, APPROXIMATE CIRCUIT COMMONLY USED

the circle has not previously been discovered in published treatments of the subject.

The characteristics of the induction motor are commonly shown by the circle diagram corresponding to the approximate equivalent circuit of Fig. 1. It has been shown by K. J. Laurell* that the current locus for the exact equivalent circuit (Fig. 2) is also a circle.

The size of the circle may be determined from test data by the no-load and locked-rotor current vectors, provided that the position of the base line is known.

*"The Exact Circular Current Locus of the Induction Motor," Laurell. ELECTRICAL WORLD, July 11, 1908.

By the base line is meant the line drawn from the no-load current vector I_0 on which the center of the circle lies; this base line may be horizontal, or it may point either above or below the horizontal depending on the relative magnitudes of the various motor constants.

The angle ϵ which this base line makes with the horizontal may be expressed approximately by $\sin \epsilon = \frac{2I_0}{E_0}(r_1 \sin \theta_0 - x_1 \cos \theta_0)$† where r_1 and x_1 are the primary resistance and reactance and I_0, E_0 and θ_0 are respectively the no-load current, the voltage and the angle between them. This equation is derived in "Appendix."

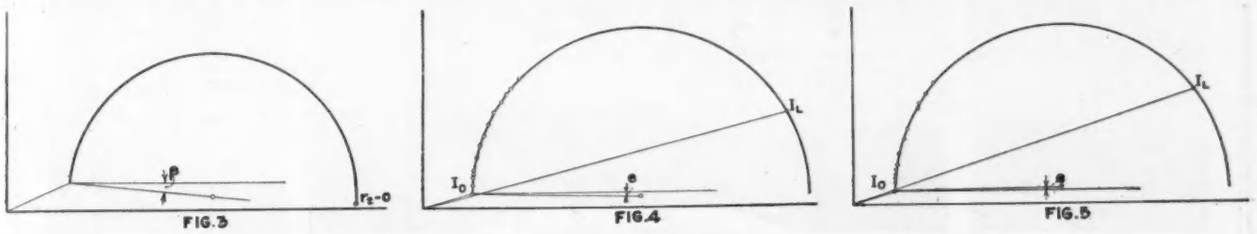
The equation indicates that the base of the circle may tilt either up when $r_1 \sin \theta_0$ is greater than $x_1 \cos \theta_0$ or down when $x_1 \cos \theta_0$ is greater than $r_1 \sin \theta_0$. Table I illustrates the effect due to variations of primary resistance and reactance when the excitation "constants" (g and b) and the secondary reactance are constant. It will be noted that the numerical value of primary impedance is constant although the proportions of resistance and reactance are varied. Not only is the diameter of the current circle greatly changed, but the base line of the current circle is tilted. A graphical construction would also show that the secondary voltage is shifted.

Case 1 shows the results of constants such that the base is horizontal. It will be noted also that the no load I_0Z_1 drop is in phase with E_0. In case 2 the primary resistance is increased and the reactance reduced to zero, causing the circle to tilt up. In case 3 (see Fig. 3) the primary resistance is reduced to zero and the primary reactance increased, causing the base of the circle to tilt down. The following table summarizes these results:

Case	r_1	x_1	I_0	Coordinates of center	Radius	Sin ϵ Approximate	Sin ϵ Actual
1	0.5	1	8.9 +j4.45	29.8+j 4.45	20.9	0	0
2	1.12	0	8.88+j5.67	47.9+j14.02	39.9	0.109	0.209
3	0	1.12	9.2 +j4.04	29.2+j 2.01	20.1	—0.091	—0.101

Figs. 4 and 5 show circles of current locus for commercial motors under abnormal conditions to demonstrate the fact that the base line may tilt down as well as up. In each case the motor was run at 50 per cent overspeed, and external resistance and reactance were inserted in the primary leads. This reduced the flux density with small change in core loss and increased the effect of leakage. The test points of current values show close agreement with the circles which are drawn through the values of no-load current, locked rotor current and with the center on base line shown at angle ϵ. Figs. 4 and 5 show both positive and negative values of angle ϵ. The motor was loaded by a generator to obtain data for test points. For commercial motors the primary reactance and resistance may be assumed to be one-half the total reactance and resistance.

In actual motors there is great difficulty in obtaining the constants shown in the equivalent circuit because of their inter-relationships for any reading. This difficulty is increased because of the variation of the so-called "constants" with loads and consequent saturation in commercial motors under normal conditions.



FIGS. 3, 4 AND 5—EXAMPLES OF BOTH UPWARD AND DOWNWARD TILTING OF CIRCLE

Fig. 3—Calculated circle based upon assumed values in Table I. The constants used in this case are $E_0 =$, $r_1 = 0$, $x_1 = 1.12$, $g = 0.05$, $b = 0.1$, $x_2 = 1.0$. Figs. 5 and 6 show actual results by testing motors with selected primary resistance and reactance.

Appendix.—In the following derivation the notation in Laurell's article is used. The equation of the circle is

$$(G - m)^2 + (B - l)^2 = n^2, \quad (1)$$

where G is the equivalent conductance of the motor for any load, B is the equivalent susceptance of the motor for any load.

$$l = \frac{b(x_1 + x_2) + \frac{1}{2} + x_1 x_2 y^2}{A},$$

the abscissa of the circle's center; (2)

$$m = \frac{br_1 + gx_2 + r_1 x_2 y^2}{A},$$

the ordinate of the circle's center; (3)

$$n = 1/2A, \text{ the radius of the circle} \quad (4)$$

$$A = x_1 + x_2 + bZ_1^2 + x_2 y^2 Z_1^2 + 2bx_1x_2 + 2gr_1x_2 \quad (5)$$

$$y^2 = g^2 + b^2 \quad (6)$$

The letters correspond to the parts of circuit in Fig. 1. For no load the value of r_2 is infinite and

$$G_0 = (r_1 y^2 + g)/D \quad (7)$$

$$B_0 = (x_1 y^2 + b)/D \quad (8)$$

where $D = 1 + Z_1^2 y^2 + 2r_1 g + 2x_1 b$. (9)

The values of m, A, G_0 and B_0, by neglecting values of shunted admittance of the second degree, are

$$m = \frac{br_1 + gx_2}{A} \quad (10)$$

$$A = x_1 + x_2 + bZ_1^2 + 2bx_1x_2 + 2gr_1x_2 \quad (11)$$

$$G_0 = \frac{g}{1 + 2r_1 g + 2x_1 b} \quad (12)$$

$$B_0 = \frac{b}{1 + 2r_1 g + 2x_1 b} \quad (13)$$

Sin ϵ equals the difference between the ordinates of the no-load vector and the circle's center divided by the radius, or

$$\sin \epsilon = (m - G_0)/n \quad (14)$$

$$= 2mA - 2G_0A, \quad (15)$$

and, substituting the approximate value from (10)

$$\sin \epsilon = 2br_1 + 2gx_2 - 2G_0A. \quad (16)$$

Substituting for b and g from equations 12 and 13 and again neglecting terms of second degree of shunted admittance,

$$\sin \epsilon = 2r_1B_0 - 2x_1G_0 \quad (17)$$

or

$$= \frac{2I_0}{E_0}(r_1 \sin \theta_0 - x_1 \cos \theta_0) \quad (18)$$

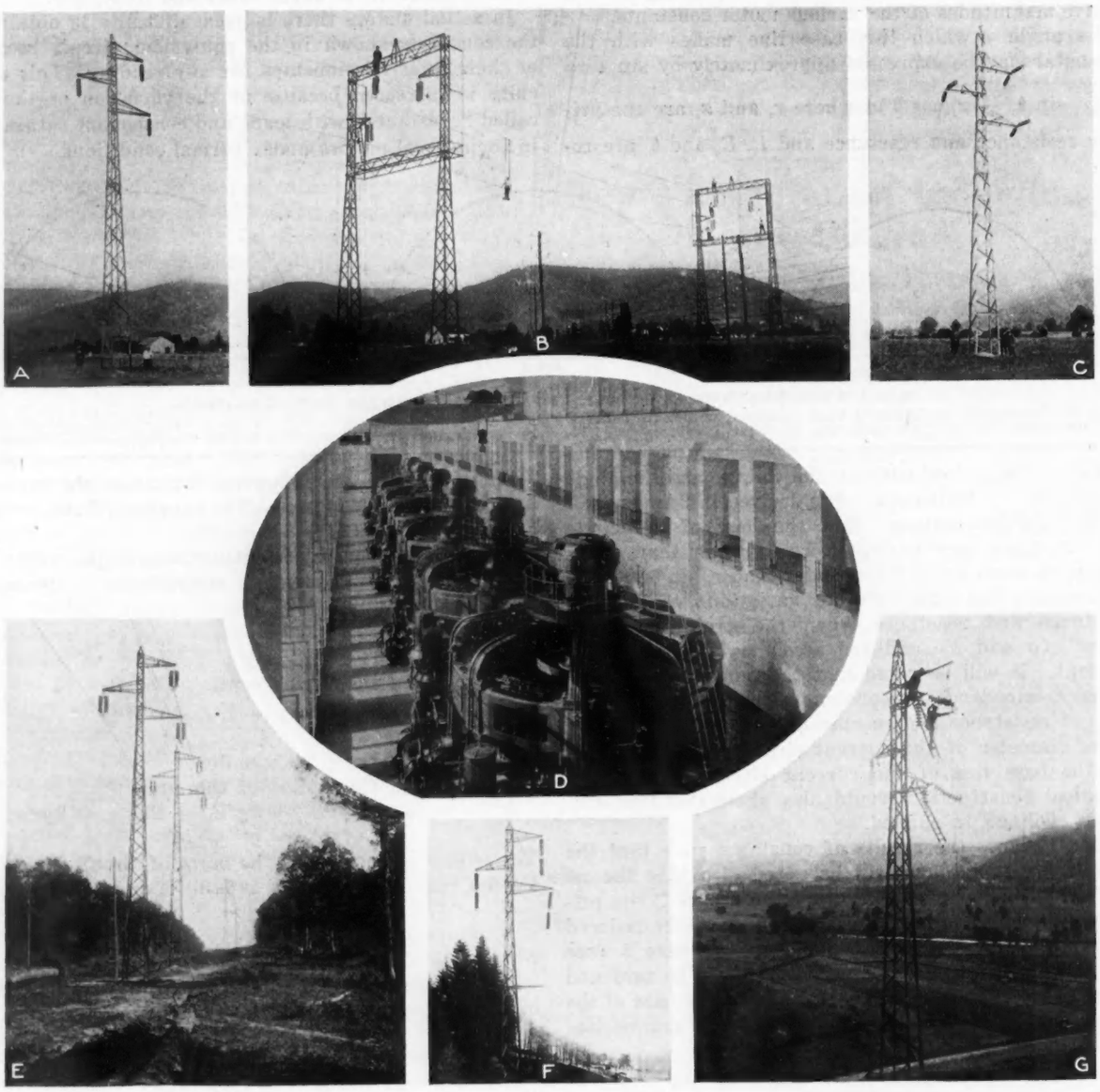
where θ_0 is the angle between I_0 and E_0.

†Heyland gives this value $\sin \epsilon = 2I_0R_1/E_0$, which is similar to the first term

Specht gives this value $\tan \epsilon = \frac{2I_0(r_1 + x_1 + x_2)\cos \theta)}{E_0}$

See ELECTRICAL WORLD, Feb. 25, 1905.

110,000-Volt Transmission System Built by the French



A—Standard tower for straight line.
B—Careful construction at railroad crossing.
C—Angle tower construction.
D—Generating plant in Switzerland has six 7,500-hp. units, supplying energy for distribution in France.
E—Crossing a telephone line.
F—Additional insulator strings to prevent swinging.
G—Mounting insulators on angle tower.
H and I—Outdoor switching structure and substation at Delle, where the transmission line enters France.

French Transmission Line for 110 Kv.

Delivers Energy from Hydro-Electric Plant in Switzerland to France—Considerations Which Led to Design Adopted for Transmission Line Over 115 Miles of Mountainous and Wooded Country—Operated at 70 Kv. at Start

By M. A. HENRIOD*
Electrical Engineer, Paris, France

A TRANSMISSION line was erected in 1918 and 1919 between Switzerland and France to permit the Compagnie Lorraine d'Electricité to receive hydro-electric energy from the power station built at Goesgen, Switzerland, on the Aar River by the Société Motor. The distance of 115 miles (185 km.) between the power station and the receiving substation made desirable a transmission voltage of 110,000. The system is operated temporarily at 70,000 volts, but the stations and line are equipped for the final voltage. Information available deals principally with the installation on French territory and gives details on the erection of one of the first transmission lines equipped in France for 110,000 volts. The matter is of particular interest because the actual data and operating considerations upon which the design was based are made available in concise form.

In order to meet the requirements resulting from the war the Compagnie Générale d'Electricité, on the request of the Ministère de l'Armement, was retained at the beginning of 1918 to study the erection of a transmission line, to be put into operation in the shortest time, to carry into France the hydro-electric energy available in Switzerland. The work began in July, 1918, was prosecuted energetically despite the difficulties of the time and was completed in one year, the line being ready for operation on Aug. 10, 1919.

The orders for steel, copper, insulators and other appurtenances for both sections of the line were combined, thus allowing more uniformity in the choice of the material and making better delivery possible.

On account of the long distance and the capacity of the line, which is 20,000 hp., the transmission voltage of 110,000 was chosen; so that with a power factor of 0.8 at the substation of the Compagnie Lorraine d'Electricité at Pouxeux, the ohmic losses are limited to 10 per cent and the voltage drop is not over 15 per cent. It was decided to operate the system at first at 70,000 volts in order to allow immediate connection with the network of the Compagnie Lorraine Electricité already operated at that voltage.

The hydro-electric plant of Goesgen, built between Olten and Aarau, uses the power of the Aar River under a 55-ft. (16.7-m.) head at low water, with an output of 12,360 cu.ft. (350 cu.m.) per second. Of eight units of 7,500 hp., six are now installed and supply three-phase current at 8,000 volts, 50 cycles. The amount of energy to be exported is sent out from a substation in the same building as the power station and equipped for the final voltage of 110,000.

Right-of-Way.—The right-of-way of the line has about the same total length on Swiss and on French territory. It goes through a country of mountains and forests, which made the plotting rather difficult as the route had to be as direct as possible and also easily accessible.

From Goesgen the line proceeds north to near Basle, touches the Bottmingen substation, follows the Alsace border and enters France at Delle, where the connecting and metering substation is provided. Then the line goes on the left of Belfort, crosses the Vosges Mountains at Planches les Mines and Corravilliers and joins the Moselle River at Rupt, following the valley to Pouxeux. The lowest point of the line is near Morvillars at the altitude of 1,112 ft. (339 m.). The highest point is at Belfahy at 2,900 ft. (884 m.). Between Servance and the Mont de Fourche the altitude varies between 1,970 ft. (600 m.) and 2,295 ft. (700 m.), going down suddenly to the Moselle River at 1,395 ft. (425 m.).

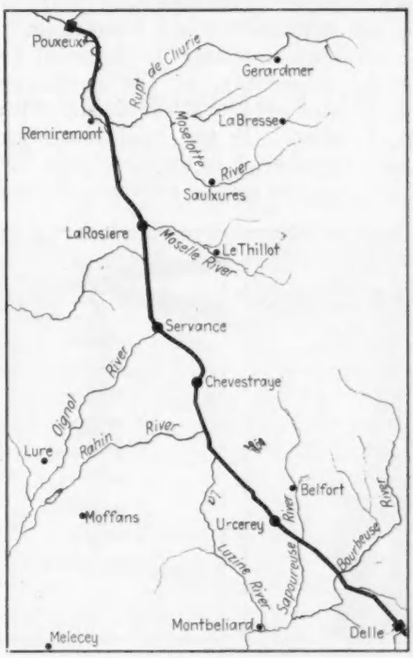


FIG. 1 — PORTION OF TRANSMISSION LINE ON FRENCH TERRITORY

The line is entirely built on steel towers, which support three conductors and one ground wire for the purpose of equalizing the potential of the towers, of which it also completes the grounding, adding a protection against atmospheric disturbances.

On the theory that the insulators are the weak point of any transmission system—it is known that probably 45 per cent of the troubles occur at the insulators—a very long span has been adopted. Owing to the high cost of the insulators and the difficulties in buying them it was advisable to make a careful choice of the special types on the market for high tension.

Considering the characteristics of the line and the price of the material, the economical span has been found to lie between 590 ft. and 650 ft. (180 m. and 200 m). The first figure has been adopted as standard span, but in a few cases, where there was no choice as to location of towers, some spans of 985 ft. (300 m.) have been erected. On the Swiss section there are a few spans of more than 1,600 ft. (490 m.).

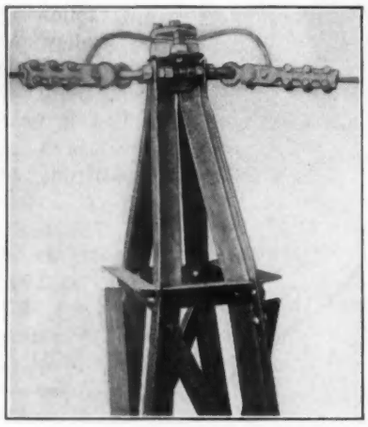
*Translated from article by Paul Meyer in *Revue Générale de l'Electricité*. The translation has been somewhat condensed.

The use of long spans, which is very far from the standard French practice, required long stretches of straight line and the use of high towers. On the other hand, it had the advantage of reducing the number of insulators and also the amount of land to be bought from the farmers. Regarding the question of safety, experience with similar installations in America and Europe has shown perfectly good operation for many years with spans of about 500 ft. (150 m.). Furthermore, with the diameter of the present conductors the danger of mechanical breakdowns is positively offset, as it is known that the overloads due to sleet and snow affect the conductors of large diameter less than those of small diameter.

Two Standard Towers Adopted

In order to realize the standardization of the material there has been an attempt to limit the various types of towers to a minimum. They have been designed in two types which are suitable for any conditions.

The type A for straight line only is designed to carry the load of the conductors, of the insulators and of the wind on a span of 590 ft. (180 m.) with a factor of safety of three. On the road crossings, the towers being closer together, it is easy to obtain the factor of safety of five required by the government regulations. The weight of this tower is 2,866 lb. (1,300 kg.), and it is built of three conical sections connected on the field with bolts. The dimensions of the upright angles, which are given in millimeters because they do not correspond to the American standard, follow: First section, 80 x 80 x 8 mm.; second section, 70 x 70 x 7 mm.; third section, 60 x 60 x 6 mm. The width at bottom is 4.2 ft. x 4.2 ft. (128 cm.), and the width at top is 1.3 ft. x 1.3 ft. (40 cm.).



FIGS. 2 AND 3 — DEAD-END OF GROUND WIRE ON ANGLE TOWER AND SUSPENSION STRING WITH SAFETY CLAMP

The type B for dead-end is also used on the angles up to 135 deg. This angle has never been exceeded in the setting of the line. As in the case of the straight-line tower, type A, the dead-end tower is built of three sections bolted together. The weight is 5,508 lb. (2,500 kg.). The dimensions of the upright angles are: First section, 100 x 100 x 10 mm.; second section, 90 x 90 x 9 mm.; third section, 80 x 80 x 8 mm. The width at bottom is 4.9 ft. x 4.9 ft. (220 cm.), and the width at top is 1.7 ft. x 1.7 ft. (77 cm.).

The steel used in the construction has an ultimate strength of about 60,000 lb. per square inch (4,200 kg. per sq.cm.) and an extension coefficient of 18 per cent. The height of the tower is 65 ft. (20 m.) above the ground. The height of the lowest cross-arm is 45.9 ft. (14 m.) so that in a span of 590 ft. (180 m.) and with a temperature of 95 deg. Fahr. there is at least 23 ft. (7 m.) between the lowest point of the sag and the ground level.

All the towers are erected on concrete foundations of which the size depends on the kind of ground. In order to prevent rusting, the flanges of the uprights are on the outside so that the water can flow down easily and will not accumulate and stay at the riveting point of the braces.

The three conductors are carried at each corner of a triangle measuring 11 ft. (3.4 m.) on the vertical side and 14.7 ft. to 15.6 ft. (4.5 m. to 4.75 m.) on the two other sides. The length of the shortest cross-arm is such as to prevent any arcing between the conductor and the tower when the swinging of the conductors reaches 40 deg. because of a wind exerting a force of 25 lb. per square foot (0.012 kg. per sq.cm.).

Providing Against Conductor Movement Due to Sleet

The lowest cross-arm is offset 1.8 ft. (55 cm.), so that it will balance the shortening of the space between two phases on the same side when the sleet and snow on the upper conductors produce abnormal stresses due to unbalanced conditions of load. After experience in operation and in the most affected places this shifting may be doubled, and an additional string has been secured on the upper cross-arm in order to pull the upper conductor 1.7 ft. (50 cm.) closer to the tower and thus obtain a space of 3½ ft. (106 cm.) between the vertical planes of the conductors. At the beginning the arrangement of the three wires on a horizontal plane had been considered. The greater weight of the towers, their size and the difficulties of erection in a very rough country have led to the abandonment of this plan, which was after all very much more expensive.

The ground wire is in the center and on the top of the tower, 8 ft. (2.4 m.) above the upper conductor. It is secured to special clamps bolted on the top of the tower with lead sheets inserted between. On the angle towers strain clamps secure the steel wire on each side of the main clamp so that it remains flexible enough to avoid the wearing resulting from the oblique pull. Ground plate of copper of 1.4 ft. x 1 ft. x $\frac{7}{64}$ in. (42 cm. x 30 cm. x 2.8 mm.) is connected to a tinned wire of $\frac{1}{4}$ in. (6.3 mm.) to provide a perfect ground on each tower.

The crossing of three main railroad lines has required the erection of special steel structures. The three conductors are triple-stranded and secured to double strings of insulators. When crossing the telephone lines some special grounding nets have been provided between the high-tension line and the telephone. In special points the factor of safety has been increased by doubling the strings and by adding wire guards.

Eight Suspension Units in an Insulator String

The strings of insulators are provided with eight porcelain units, as shown in Fig. 3. At strain points or at angles they are provided with nine units.

These units, of the cap-and-pin type, are brown-glazed and connected together by the ball-and-socket arrangement; a suspension eye secures the string on

a link bolted on the cross-arms, and the conductors are supported by clamps, which are, of course, of different designs for strain and for suspension purposes.

Each unit has a diameter of 10 in. (25.4 cm.) and a weight of 7.9 lb. (3.6 kg.), and the length of the complete suspension string is 4 ft. 2 in. (1.27 m.).

The conductors are of electrolytic copper with a resistivity of 10.7 ohms per circular mil-foot at 20 deg. C. and a mechanical ultimate of 51,600 lb. per square inch (3,610 kg. per sq.cm.). They are made up of seven strands, giving a total cross-section of 153,933 circ.mil and a diameter of $\frac{33}{64}$ in. (11.6 mm.).

The sags and tensions have been established so as to limit the tension of the copper to 11,360 lb. per square inch (795 kg. per sq.cm.) except at the special points where a factor of safety of five is required. With the normal span of 590 ft. (180 m.) the sag does not exceed 23 ft. (7 m.) at 95 deg. Fahr. The ground wire is of galvanized steel of 78,940 circ.mil, $\frac{5}{16}$ in. (8 mm.) in diameter, made up of seven strands of a mechanical resistance of 99,300 lb. per square inch (6,950 kg. per sq.cm.). This wire is pulled in order to not exceed 17,000 lb. per square inch (1,190 kg. per sq.cm.).

The splicing of the conductors was done by means of the Schlick connector, which is in bronze with concentric cones, although a copper splicing sleeve twisted around the conductor ends was used in some sections. The mechanical tests showed that the conductors broke before any slipping of the connectors took place.

The unbalanced conditions resulting from the different capacities of the conductors are compensated for by a transposition at Bottmingen and at Delle.

Erection of the Line.—On account of the rolling land the location of each tower required the computation of the graphical curves established in function of the spans for the extreme temperatures of —4 deg. Fahr. and +95 deg. Fahr. (—22 deg. C. to 35 deg. C.).

The strain towers are spaced from 3,300 ft. to 3,950 ft. (1,000 m. to 1,200 m.). They are closer together in the mountainous section, but in their location the profile is always taken into account. In a few special cases where the insulator strings might have been lifted up at low temperature, and also in order to avoid need of erection of a special strain tower, the suspension strings have been provided with an additional string under the conductor to hold it down.

In order to obtain very long stretches of straight line and to reduce the angles, the woods and large forests have been traversed by opening a right-of-way wide enough to prevent falling trees damaging the line.

Towers Partially Assembled Before Transportation

The transportation of the towers was relatively easy on account of their construction in three sections and also because of the arrangement of the angles of the uprights, which permitted one section to be put inside of another. In special cases where the roads were too far from the location of the tower or where the slopes were too heavy the towers were carried to place of erection, each section separately, so as to avoid the handling of pieces heavier than 1,550 lb. (700 kg.) with a maximum length of 25 ft. (7.6 m.). The towers were erected with the aid of a hoist or a pulley.

The conductors, carried on special trucks, were laid by lengths of 3,280 ft. (1,000 m.) and immediately hung on pulleys secured at the same level as the clamps of the string of insulators. The tension and the adjustment of the conductors were checked with a dynamometer.

The erection of the transmission line on French soil required 850 tons of steel, divided among 542 steel towers and structural work segregated as follows: Four hundred and thirty-four suspension towers, ninety strain and angle towers, five canal crossings, six railroad crossings, seven special structures for switches, endings and telephone protection devices. In addition, 440,900 lb. (200,000 kg.) of copper conductors, 63,000 lb. (28,600 kg.) of steel strand, 19,000 insulators and 1,200 tons of cement were used. One hundred and twenty towers erected on rock necessitated blasting, and sixty tower foundations required electric pumping. The erection of this line was started with the help of Kabyle and Moroccan soldiers, and after the armistice it was completed with civilian labor.

Further information concerning the substations at Pouxeux and Delle will appear in an early issue.

Tendencies in Utility Financing

Needs for Soundest Possible Financing Loom Large—Encouragement of Consumer Ownership Will Strengthen the Position of Utilities

By A. N. Kemp
Vice-President Southern California Edison Company

WITH the tremendous development requirements facing our public utilities it is obvious that in order to keep pace with the growing demands upon them a proper provision for their financing is a subject for most thoughtful consideration. Development of utilities to meet the ordinary growth of business was impeded during the war. Money was diverted into the financing of our military activities. The man power of the country was enrolled in service. Freight embargoes and many other conditions incidental to the all-absorbing purpose of winning the conflict either stopped or curtailed normal development. We therefore face a condition where funds must be provided for the extension of our railroads, the overloaded condition of our telephone system must be relieved, gas utilities must find the funds to extend their facilities—but among the most important of these requirements is the necessity of developing hydro-electric energy.

Greater utilization of electrical energy and the substitution of other forms of power in this post-war era are forcing the electrical utilities to expand their physical properties in order to meet definite requirements for new business. This is particularly true of the hydro-electric companies. Many new uses are being found for electricity, both for domestic and industrial purposes, and demands are being accentuated by the realization of the limitations attached to other forms of power. It appears certain that many of the steam railways of the country will be obliged to electrify within the next few years. This has already been achieved in some of the mountain states, and those railroads are indeed fortunate which operate where water power is available.

While much of the potential energy of the falling water of our mountain streams has heretofore been allowed to go to waste, we have been ruthlessly and extravagantly consuming our natural resources of fuel. Scarcely had it been comprehended that a world war was impending than a shortage of the coal supply be-

came felt. Oceangoing craft were made over to consume oil instead of coal, and this condition became quickly apparent in the shortage of oil and its consequent increase in cost, and scarcity of both coal and oil was again reflected in the expense of producing gas and electrical energy.

BILLION DOLLARS NEEDED

The capital requirements of public utilities in this country during the next decade will therefore be enormous. Looked at from various points of view, it is estimated that the money to be spent in the development of hydro-electric utilities alone during the next ten years will reach and possibly exceed $1,000,000,000. Facing us is the problem of how the means are to be provided for carrying out these required developments. It is virtually impossible to find actual or prospective owner-stockholders willing or able to provide the total of such a large sum of money. Therefore we must look further afield to the custodians of trust funds, the savings institutions, life insurance companies and other investors requiring a security of a fixed maturity and yield with a large margin of safety, secured by the property of the utilities. This source of funds is reached by the sale of bonds and leaves the remainder to be provided by the utilities' owners or shareholders.

Just as the very foundations of manufacturing, commerce and trade are based on credit, so are the public utilities built on a similar foundation. As the stockholders provide the sufficient margin of equity, investors are to be looked to to provide the remaining wherewithal to carry on the necessary development work. It is an axiom that any utility manager prefers partners to creditors, but the amount involved is so great that utilities perforce must look to the loaning public for a substantial part of their financial requirements.

RATIO OF BONDS TO INVESTMENT

Opinions differ as to the proper ratio of these borrowed moneys to the total investment, but it is generally agreed that a maximum of 75 per cent of the cost of extensions may be so borrowed with propriety and safety, although some contend that 50 per cent as a maximum is a more conservative rate. Considering the discount at which securities are very apt to be sold in these times, with bonds issuable for 75 per cent of the cost of construction, it generally results in not more than 60 or 65 per cent of construction funds being provided by the sale of bonds.

Unlike ordinary business, which is unrestricted by regulation in the handling of its affairs and enabled to make large earnings, regulation of the public utilities has reached the stage where their securities are essentially of a most conservative nature. This not only applies to the mortgage indebtedness upon the property of the utilities, but to its junior securities—debentures and stocks. Many safeguards are being thrown around such securities by regulating bodies.

Public utility commissions derive their authority from the people, and their accountability to the people is reflected in their actions. In order to encourage the investment of capital to permit the development of public utilities their securities are being stabilized to an extent which was unheard of in the days before rates were regulated or the issuance of securities scrutinized by state authority. For instance, public utility commissioners are going on record as favoring a contingency or financial reserve to insure the continuity of dividend payments during years of low operating costs, so that at times when, owing to abnormal conditions, the net earnings of utilities may be reduced invested capital will continue to earn and receive its just wages. Rewards for efficiency have been allowed whereby higher returns have inured to the benefit of the utility owners, and in general it is evident that the regulating bodies have awakened to a realization of the needs of public utility development.

It is conceded that in the interest of the stockholders two-thirds of the invested capital should be provided from the proceeds of bonds, leaving the remaining one-third to be provided by the owners through the sale of preferred or common stocks. Preferred stock should be limited as to dividends, but of a higher rate than the bonds, so as to reach that class of investor desiring a conservative investment with a higher yield. Common stock, being unlimited as to dividends, however, appeals to the partner-stockholder. He is the real owner of the property and is the one to whom the larger returns should go.

UTILITY STOCKS ATTRACTIVE

Granted a fair return on the invested capital, which the most conservative now place at not less than 8 per cent, and which in the opinion of many financial experts should be from 10 to 15 per cent, utilities may borrow a substantial part of their requirements at a cost somewhat less than the allowed return, so that the remaining difference may be applied to an increase in the return available for the stockholder. In spite of the fact that because of the necessity of building up equities and the maintenance of adequate reserves conservative financing precluded the payment of a utility's entire earnings in dividends, present-day regulation properly permits the payment of dividends on stocks at a rate which, in view of the safety insured by the principles above set forth, makes them most attractive. It is reasonable to assume, therefore, that this development need of our public utilities will be met through the sale of their bonds to investors of one type, preferred stocks to those of another type, and common stocks to those who become their partners.

Now that the people in many sections of the country are coming more and more to regard our public utilities as their own home projects, serving their own necessities, and to realize that upon the growth of such service depend the extension of business and agricultural development, the establishment of manufactures and the general prosperity of their community, they are giving an earnest and sincere co-operation by becoming partner-owners in the properties supplying this service. This form of public ownership is being encouraged by the utilities. As securities are being sold direct in large quantities to consumers and people in the territory served, this sort of co-operative ownership creates a substantial and enduring safeguard to other security holders of the company which increases and broadens the investment market not only for the utility's junior securities but for its bonds as well.

The two leading hydro-electric utilities on the Pacific Coast have been pioneers in this work and have sold many millions of dollars of stock to thousands of their consumers. Individual holdings are small, averaging in the neighborhood of ten shares, but the number of stockholders obtained is considered quite equal in importance to the number of shares sold. These small buyers invest on the theory that their stock will yield a

satisfactory dividend return while their investment will go to the development of their own community. Many purchases of stock are made in such amount as to provide for the payment of lighting or power bills out of dividends. This purchase of securities by consumers is a most healthy indication. When a large percentage of its consumers are security holders a company is indeed built on a rock which cannot be shaken. It is entirely within the range of possibility that the time is not far distant when the position and stability of a public service corporation will, in part at least, be judged by the number of its customer-owners.

Public utility organizations are not made—they grow with the communities which they serve. Under normal conditions existing in a domain which has not yet approached the limitations of population and consequent community wealth, the public service must keep ahead of the demand of the consuming public, because it has been proved by experience and statistics that population and prosperity invariably follow the extension of the public service. It is unquestionably true that a public utility organization is so intimately and absolutely interwoven with the woof and warp of the community that the relation is inseparable and intensely co-operative.

Relay Selection for Large Power Systems

Considerations Governing the Choice of Relay Layout for Generators, Feeders and Tie Lines—Generators and Transformers Usually Protected From Internal Trouble by Differential Relays but Not by Overload Relays

By R. F. GOODING
Superintendent of Construction Tucker & Laxton, Charlotte, N. C.

POSSIBLE short circuits on large power systems, their intensities and ways to limit them, have been dealt with by the writer in previous issues.* It is appropriate, therefore, to go a step farther and see what relay layout such a system would need in order to insure the proper operation of the various circuit breakers. For no matter how carefully the breakers may be selected and applied, they cannot function properly unless the relays have been just as carefully applied. The setting of the relays determines the sequence in which the different breakers will operate, and an incorrect setting on one set of relays only may introduce difficulties in that entire section of the system. This being the case, the question of their application is certainly deserving of serious thought. In general it may be said that generators are commonly protected against internal trouble by differential relays, but not by overload relays, since trouble on lines or feeders should be isolated without disconnecting the generator from the bus. Radial feeders are best protected by overload relays, while the reverse-power relay or directional relay is especially applicable to parallel feeders. Transformers, like generators, are isolated in case of internal trouble by means of differential relays.

The original purpose of relays was to protect the apparatus on any circuit in case of trouble in that circuit. The idea then was to disconnect this apparatus at once in order to prevent its partial or complete destruction. Now, however, relays have a second and even more important mission, that of restoring normal conditions to the system at large in the shortest possible time. To do this they must not only localize the disturbance as much as possible but must also isolate the troubled section from the rest of the system with the least possible disarrangement to the system proper. They must discriminate between overload and reversal of power, function on predetermined unbalance of currents, and, above all, must always operate in their proper time, so that the sequence of operations will not be destroyed.

*ELECTRICAL WORLD, Oct. 18, Nov. 15 and Nov. 22, 1919; also April 3 and April 24, 1920.

In order to determine what relays to apply at various points on such a system, how and when they should operate, etc., it is necessary to make a complete and comprehensive study of the short-circuit possibilities at all points. This can be done as outlined in the previous articles above referred to. Where it is convenient to use a calculating table† this would be simpler

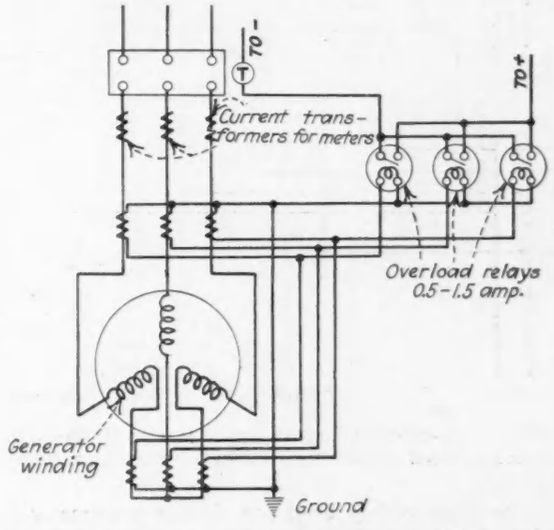


FIG. 1—CONNECTING DIFFERENTIAL RELAYS FOR GENERATOR PROTECTION

than the method outlined. However, if such a table is not to be had the method proposed before will be found to give very good results.

Knowing the short-circuit values at different parts of the system, the engineer is in position to begin the application of relays for each particular point and to determine what settings the different relays should have in order that they may function in just their proper time. No matter how carefully these data have been calculated or how closely the relays have set, there will always be considerable readjustment necessary before

†See ELECTRICAL WORLD, March 27, 1920.

the relay layout on a large system will operate properly under all conditions. It will usually take several months of this work to insure proper functioning at all points. In fact, even after the layout is working satisfactorily a change in the load at one point occasioning different transformer capacity may change the setting for relays on that circuit, and this different setting may in turn be passed on to several other points in that section of the system. Thus the study of relays is one that is never ended.

In dealing with the relays for this supposed system the writer will indicate what arrangements have given the best service to operating companies under conditions similar to those assumed in these articles. Various other combinations could be suggested, but only

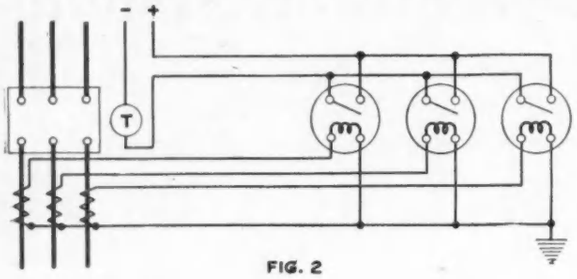


FIG. 2

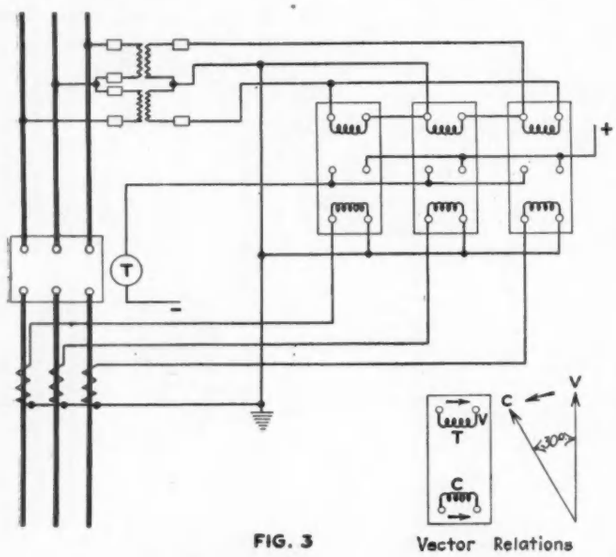


FIG. 3 Vector Relations

FIGS. 2 AND 3—OVERLOAD RELAY DIAGRAM AND REVERSE-POWER RELAY SCHEME COMMONLY APPLIED TO PARALLEL FEEDERS

the ones most widely used for similar systems will be outlined here. The relays will be considered first for the generators and then on through various steps of the transmission and distribution systems.

GENERATOR PROTECTION BY DIFFERENTIAL RELAYS

In modern stations it is customary to have no overload protection for the generators. The generator of today is built in a sufficiently sturdy way to withstand a short circuit at its terminals and therefore does not need the overload protection. Moreover, with overload relays on the generators a severe short circuit close to the bus might trip all of the generators, thus dropping the entire load of the station. This could happen only if the circuit breaker on the damaged circuit should "stick" or should be very sluggish in opening. Rather than drop the entire load it is better to have the generators stay on the bus and, if necessary, let the short circuit burn itself out, which will usually be accomplished in very short order.

If for any reason trouble develops within the generator itself means must be provided which will immediately disconnect the generator from the bus, and this is accomplished by the use of differential relays, as shown in Fig. 1.

RELAYS TRIP GENERATOR BREAKER

In this scheme all the generator leads are brought out of the machine and a current transformer is located on each leg between the armature coil and the neutral. On the line, or load, side a similar transformer is put on each lead between the generator and the bus. The secondaries of each pair of similar transformers are then connected in series, so that the current merely circulates. Across these secondaries is connected an overload relay, usually with 0.5-amp. to 1.5-amp. coils. Under normal conditions the secondary currents are equal and there is no current through the relays. But if part of the generator winding should become short-circuited this will unbalance the currents from the two current transformers on that particular leg, and this unbalanced current will then be forced through the overload relay for that circuit, causing it to close its contacts and trip the circuit breaker. These relays should be set for practically instantaneous operation, at just about 0.5 amp. (unbalanced current). This means that with 0.5 amp. or 10 per cent of unbalanced current the generator will immediately be disconnected from the bus.

Additional wiring (not shown here) should be installed in order that operation of the differential relays shall not only trip the generator breaker but also open the generator field switch, destroying the field and "killing" the generator entirely. Otherwise, even though the generator were isolated from the bus, with the field circuit still closed, it would be generating full voltage and would destroy at least part of its winding with its own power. When using this scheme it is possible to use the relay transformers for meters also, but this is not recommended, the usual practice being to supply separate transformers for metering purposes.

OVERLOAD RELAYS FOR RADIAL FEEDERS

Radial feeders, leaving the power station singly and with only one to a substation, are protected by plain overload relays. This connection, shown in Fig. 2, is probably the best known and most widely used of all of the different relay arrangements. When operating as a grounded system three current transformers and three relays are necessary in order to protect against an overload or ground in any phase. However, if the system is ungrounded the middle transformer and relay may be omitted. As most of the 2,300-volt distribution systems are ungrounded the two-relay scheme is very widely used for this class of work.

Very often there are parallel feeders running from the power station to a substation and then on to additional substations. With this scheme the feeders leaving the power station and successive substations would be equipped with overload relays, and reverse power relays would be placed on the circuits entering the various substations. The standard connection for the reverse power relays is shown in Fig. 3. Three relays are required in all cases, and, as the "vector relations" of Fig. 3 show, the current must lead the

voltage by 30 deg. This particular type of relay is really an overload and reverse power relay combined, or, as the manufacturers style it, a directional relay. Were it not for the overload feature the slightest reversal of power would trip the breakers, but, arranged as it is, it can be set to function at any predetermined amount of reversal. In many cases a reversal of full load (5 amp. secondary current) on the circuit might be permissible, in which event these relays would be set so as to pass this much power in the reverse direction, but to trip on any reversal greater than this. As will be seen later, the reverse power or directional relays play a very important part in the protection of parallel feeders between stations.

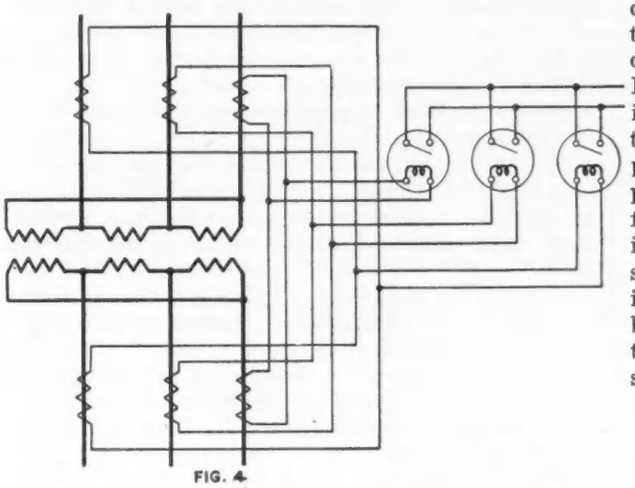


FIG. 4.

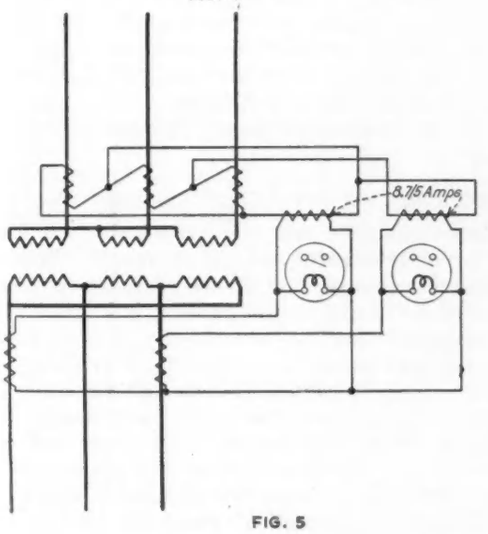


FIG. 5

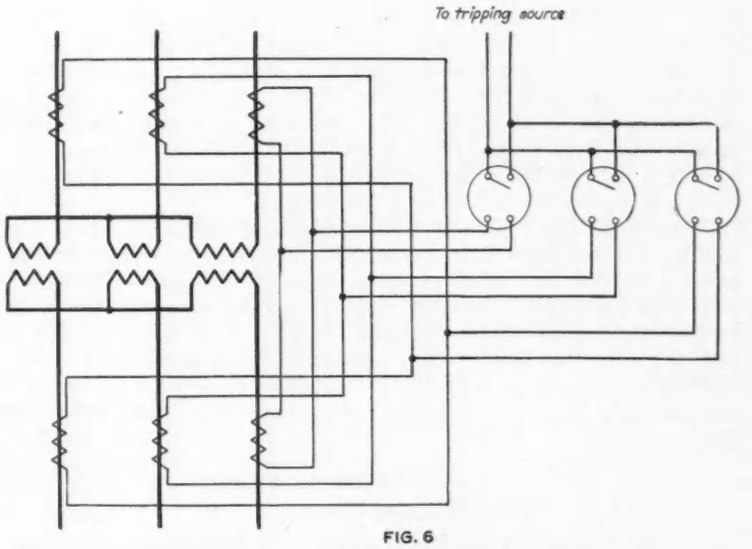


FIG. 6

FIGS. 4, 5 AND 6—APPLYING DIFFERENTIAL RELAY PROTECTION TO TRANSFORMERS CONNECTED DELTA-DELTA, STAR-DELTA AND STAR-STAR

DIFFERENTIAL RELAYS ALSO APPLIED TO TRANSFORMERS

The usual method with transformer banks is to omit overload relays and rely on differential protection, as was done in the case of the generators. Fig. 4 shows such connections for a delta-delta bank, while Fig. 5 is for a delta-star bank and Fig. 6 for a star-star bank. With a delta-star or star-delta bank this scheme requires special ratio transformers and requires considerable extra work, "phasing out," etc. The "phasing out" must, of course, be done with any arrangement, but is easier with delta-delta or star-star than with a combination of delta-star or vice versa.

A new relay has been developed called a polyphase differential power relay which simplifies the "phasing-out" work very much. It consists of two polyphase wattmeter elements on a common shaft and arranged so that their torques are opposing. One of these polyphase elements is connected to the high side of the bank, the other to the low side, care being exercised to have their torques in opposition. Under normal conditions, their torques being equal and in opposite directions, the resultant torque on the shaft will be zero and, of course, there is no tendency to trip the breakers. But if trouble develops in one side of the bank this will immediately unbalance the torques from the two sides of the bank, and when this unbalanced torque reaches a predetermined value the relay contacts will close, tripping both breakers and completely isolating the bank from the line. One big advantage of this relay is that it can be used with equal facility on delta-delta, star-star, delta-star or star-delta banks. Another thing in its favor is that the potential from the low side of the bank may be used for both of the polyphase elements, thus eliminating potential transformers on the high side.

The chief claim for differential protection for transformers is that it will isolate a bank before the internal trouble has had time to develop into a serious short circuit and by lessening the damage done to the windings will make the repair work that much less. Some engineers, however, state that it takes as much work to replace one coil as to replace several, and for this reason they supply straight overload protection on all transformer banks. General practice, however, seems to favor keeping the damage as slight as possible, and for this reason differential protection is very widely used.

In an early issue this discussion will be completed with an analysis of the action of reverse-power relays on parallel feeders and a discussion on the choice of relays for a typical system of stations, lines and substations.

Limitations of Interconnection

Rupturing Capacity of Oil Switches Under Short-Circuit Conditions Limits Interconnection Unless Plants Are Well Distributed

BY E. C. STONE
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INTERCONNECTION by its very nature always means a greater concentration of power at one point under short-circuit conditions, and the entire plant of both interconnecting systems must be mechanically and electrically able to withstand the increased strains. At the present time it is fair to assume that the short-circuit-breaking capacity of the oil circuit breaker marks this limit. The manufacturer's rating of the largest breakers made today indicates a rupturing capacity of approximately 1,500,000 kva., which is high enough by a considerable margin to take care of most systems that can be operated in parallel at the present time. The time does not seem far away, however, when present-day oil circuit breakers will be outgrown, and it may become necessary even to separate the systems of single large companies into parts.

To get an accurate idea of some of the limits the writer has made estimates on the future development of a system similar to the present system of the Duquesne Light Company. It was assumed that the various generating units of the power plants would be operated through individual transformer banks in parallel on the 66,000-volt bus only, and that the entire transmission system, operating at 66,000 volts, would be connected in parallel. Thus connected each 60,000-kw. unit would be able to deliver into a short circuit at the high-tension bus an instantaneous current of 3,400 amp.

Under these conditions the largest oil circuit breakers now built would just about break the short-circuit current of 240,000 kw. of generating capacity. If, however, this generating capacity could be divided equally between two power plants 60 miles (96 km.) apart and tied together by ample line capacity the combined capacity of the two plants could be 360,000 kw. without the maximum short circuit exceeding the capacity of the circuit breaker.

SAFE PARALLEL OPERATION DEPENDENT ON LOAD CONCENTRATION

In other words, the maximum amount of generating capacity that can be operated in parallel on a given system depends to a considerable degree on the concentration of the load. Although 240,000 kw. is the maximum capacity that can be operated in parallel on a single bus, it might be perfectly practicable to operate three or four times that capacity in parallel if it were located in several plants separated over a distance of 150 miles or 200 miles (278 km. to 370 km.).

Assuming a system of this type consisting of two power plants of 180,000 kw. each, connected in parallel through 60 miles of transmission, if synchronous condensers were installed at the substations along the transmission line of sufficient capacity to increase the power factor of the load from 80 per cent to 90 per cent these synchronous condensers would cause an increase of 25 per cent or 30 per cent in the maximum instantaneous short-circuit current which could develop on the system.

A major element in determining the magnitude of short circuit which can develop is the reactance of the system. From this point of view alone the higher the reactance the better the condition. Very high reactance, however, introduces problems of voltage regulation, power factor and synchronizing power. In this connection, however, it is interesting to consider what would happen if the natural reactance of this system were doubled. The favorable effect would, of course, be to cut the maximum short-circuit current in half. The undesirable effect would be to increase seriously the voltage regulation of the system and introduce an additional reactive component into the load at the power stations. If, however, synchronous condenser capacity sufficient to raise the power factor of the load to unity could be installed the original voltage regulation would be restored and the power factor of the system sufficiently improved more than to offset the additional wattless component due to the high line reactance. The maximum short-circuit current, including that due to the increased synchronous condenser capacity, would be about 75 per cent of what it was before the reactance was increased.

In order that power plants may operate satisfactorily in parallel when tied together through a transmission system the synchronizing power of this system must be adequate; that is, the capacity of the transmission lines must be sufficient to permit of a free flow of corrective current between plants great enough to hold them solidly in step.

In general, the larger the capacity of an interconnected system the greater will be the ratio of peak load that can be safely carried to the installed generating capacity and the nearer will be the ratio of the average load on the machines actually in service from hour to hour to their rated capacity. Both of these facts make for economy.

INTERCONNECTION FOR SWITCHING PURPOSES

So far interconnection has been discussed from the point of view of permanent parallel operation. Where this is not practicable because of the presence of some of the limitations referred to already, or for other reasons, temporary parallel operation for switching purposes sometimes proves very desirable. For instance, where the necessary synchronizing power is not available for permanent parallel operation it is possible for a few moments to parallel in the two systems and to switch over desired load from one system to the other without interruption. It is surprising how successfully this can be done on strings of line with an almost negligible synchronizing power. In almost any case the two systems will stay together for the comparatively short time necessary to complete the transfer of the load. They should then be immediately cut apart. For this sort of operation the question of the capacity of oil switches over the system in general is less important, since the chance of a short circuit developing at the moment when the two plants are in parallel is quite remote. However, the switches at the particular points where paralleling is to be done and the load transfer effected should be adequate. Elsewhere it is probably safe to provide switches only large enough to handle the short circuits of the generating capacity permanently back of them.

Where interconnection of a major to a minor power system is considered the minor system will presumably be connected to the major system through a bank of step-down transformers. These transformers must not only be of sufficient capacity to handle the load to be

taken from the major system but must be large enough for their reactance to be sufficiently low to permit of ample synchronizing power to hold the local generators in step with the major system. This last factor will require consideration, particularly when the amount of power to be taken from the major system is small compared with the capacity of the local plant. The possibility of the connection with the high-voltage system transiently raising the voltages of the local system must also be considered. Where the ratio of transformation is high, from say 66,000 volts to 11,000 volts or possibly 2,300 volts, it is probably necessary as a protective measure to ground the neutral of the transformers on one side or the other. The greatest safety, of course, is obtained when the ground is on the low-voltage side.

VOLTAGE REGULATION IS IMPORTANT

The effect of the voltage regulation of the major system must also be considered, and it must be remembered that this will be added to the voltage regulation of the local system. This may necessitate the introduction of some sort of additional local voltage regulation, which may be accomplished by the installation of synchronous condensers at the step-down transformers or by the use of induction regulators on the various feeders, or by a combination of both of these methods.

The present tendency in the use of electric power is toward more refined equipment which requires closer voltage regulation. This is true in the fields of both power and heating apparatus as well as in lighting. The question of voltage regulation is thus becoming more and more important, and too much emphasis cannot be laid on the necessity of providing uniformly good voltage for all users of central-station power.

Due consideration must be given to the rupturing capacity of oil circuit breakers on the local system. Even though the capacity of the feeding transformer bank is no greater than the capacity of the generating plant shut down, the lower reactance of the transformers will probably permit much heavier short-circuit currents to develop. If the circuit breakers installed are not adequate a large amount of very annoying trouble is bound to develop.

In operating a small power plant on a major power system considerable attention can properly be given to governor setting. It the governor is properly adjusted the smaller plant will run along on an almost constant load, leaving the larger system to handle the swings. This will materially improve the local boiler operation.

In running a small plant in parallel with a larger system it is quite essential that the voltage regulation of the larger system be fairly good; otherwise there will be a tendency to hunting due to sudden changes in phase displacement caused by the poor regulation of the major system.

The interconnection of a major to a minor system when the minor system does not generate is much simpler than the preceding case, since the problems of parallel operation of the smaller plant do not need to be considered.

In this case the essential points are the proper protection of the system from high-tension disturbances through grounding of the neutral, the proper solution of the voltage problem by the use of synchronous condensers and induction regulators, and the installation of circuit breakers of adequate rupturing capacity to take care of the conditions arising from being connected to the larger systems.

It will not always be found necessary to ground the neutral at the point of connection with the major system, but conditions should always be studied in regard to this point and the protection of the grounded neutral should be provided when found necessary.

There is already in operation in the New England States an interconnected system embracing a considerable number of power plants varying over a considerable range of capacity and including both steam and hydraulic. On this system a distinct saving in plant capacity required to handle the load and in costs of producing energy is made by parallel operation. If the superpower project for the Eastern district is carried out as contemplated all of these stations and many others will, of course, be tied in to the superpower system.

This subject was also discussed at a recent meeting of the Transmission and Distribution Section, Ohio Electric Light Association.

Electrification of the Upper Rhone District

NATIONAL and complete hydro-electric development of the Upper Rhone, which now serves two Swiss plants rated at 18,000 hp. and three French plants, of which the largest, at Lyons, is of 30,000 hp., while a plant of the same rating as the last named is being erected to transmit power to Le Creusot at 130,000 volts, has for a considerable time been the concern of the French authorities. The difficulties, says the French Commission in the United States, have been principally those of the choice of the right place to build barrages. A joint agreement with Switzerland for the use of Lake Geneva as a regulator for the Rhone has been made. The increase in the level of Lake Geneva brought about in 1918 has added 63,000,000 kw.-hr. to France's power supply and 13,500,000 kw.-hr. to Switzerland's.

Switzerland, which wishes to see the Rhone open to navigation and which cannot undertake the expenditure necessary to the regulation of the lake to permit this, has been more than willing to enter into any agreement proposed.

An electrical engineer employed by the French government to examine water-power possibilities of the Upper Rhone, estimated that the fall of 69 m. at Frontière Génissiat would make available 200,000 hp.; that the fall of Eilloux, of 7 m., would make available 164,000 hp.; that the fall at Boursin-Maty, of 19 m., would make available 53,000 hp.; that the fall at Chanar-Brens, of 19 m., would make available 24,500 hp.; that the fall of Tremurs-Groslée, of 12 m., would make available 297,000 hp.; that the fall of Sault-Villette d'Authon, of 12 m., would make available 29,700 hp., a grand total available of 395,000 hp.

This total would make available 4,000,000,000 kw.-hr. per annum, which would equal a saving in coal of 4,000-000 or 5,000,000 tons per annum.

Concessions for the construction of plants at all of the falls mentioned above have been obtained from the French government and the work of construction has actually started on the first four. Plants, the French authorities say, will have been constructed at all of the falls by the end of 1925, and the whole of the great industrial region in the neighborhood of the Upper Rhone will then be served with a comparatively cheap electric power.

Readers' Views and Comments

This is a readers' forum. Comments on questions before the electrical industry presenting economic, financial, engineering or commercial aspects and new or supplementary viewpoints on published articles are cordially invited

Co-operation of Technical and Practical Men in Industry

To the Editor of the ELECTRICAL WORLD:

SIR: During these days of industrial readjustment there is an opportunity to give more careful consideration to the problem of the relation of the technically trained man to the man following a trade. Many considerations in the past months have brought this matter into the foreground. Readjustments of wages, salaries and working conditions to meet the high cost of living have injected increased interest into the situation as to whether proper recognition has been made of the relative value of these two groups of men.

During the past year, on convention platforms as well as on graduating platforms, the old skeleton of the "white collar versus the overalls" has been dragged out, and after rattling it a few times it has been left without any real diagnosis being made or any verdict rendered. There would seem to be no ground for believing that the relation of the technical graduate to the man who has mastered his trade in the shop is one of antagonism, or that it should be. Both men are needed today in solving the great problems of development and conserving our resources, and both will find opportunity to serve in these days of "super-achievement" as industry launches out into a new era of activity. The two men are called to work in different atmospheres, but both must have constructive minds.

That there has been more or less misunderstanding between these two groups is evident. I recently heard an address given by a man skilled in construction work in which he said that college graduates in his employ did not know how to light a blowtorch. How many schools today would draw a large enrollment if they put on a course on "blowtorch engineering"? The cartoonist takes delight in picturing the agricultural college graduate trying to milk a cow on the wrong side and in similar gibes at college men. Such things are not a criterion of the standards by which to measure a technical graduate. The existence of the blowtorch has only been made possible by careful and patient investigation of the laws that govern combustible material and how they may be controlled. Such investigation, accompanied many times by sacrifice, has been carried out by the technically trained man. The problem of a new supply of energy to take the place of our coal as its quantity becomes limited will be left to the technical man to solve.

If the man in the shop looks at the college-trained man as a sort of an overgrown mushroom and in return the graduate looks at the shopman as a mere machine, then both are wrong. It is easy to overestimate one's self and underestimate the other fellow. Organizations have reported that recent graduates have applied for situations and have expressed their willingness to work for salaries ranging from $8,000 to $10,000 a year! Both groups should feel that their training is not a mark of complete fitness for being useful, but rather the laying of a cornerstone for building upon, through co-operation, in order to produce more efficiently that which satisfies the needs of mankind.

How can this spirit of co-operation be fostered? I know of a large electrical manufacturing company—and it is perhaps only one of many—that pays cash prizes to the men at the bench for such suggestions as are of value in the making of a machine part. Under such a plan the machinist develops the power of constructive thinking, becomes more valuable to his employer and lays the foundation for greater recognition in directing the particular industry in which he is engaged. Some of our colleges are working hand in hand with the manufacturers in adopting a program which gives the student alternate training in the classroom and in the shop. The student gets a better appreciation of the atmosphere that surrounds the man in the factory and prepares the way for cordial relations in the future as he graduates and enters his chosen profession.

The discussions, then, of our convention speakers, of the classroom instructors and of the press should not only be along the line of evaluating men according to the work which they select as their chosen vocation, but also should emphasize that the work of planning is equal in importance with the work of executing the plans, and that to insure the success of either there must be the friendliest co-operation between the two classes of workers.

HOWARD D. MATTHEWS,
Head of Electrical Design Department.
School of Engineering of Milwaukee,
Milwaukee, Wis.

Refilling Fuses Is Hazardous

To the Editor of the ELECTRICAL WORLD:

SIR: In the issue of the ELECTRICAL WORLD dated April 9 an article by H. S. Rich describes "methods for refilling inclosed fuses," and the apparent assumption is that by following the practices set forth a correct and safe fuse can be insured. This illustrates a too common misapprehension regarding the character and requirements of fuses, many people believing that any fuse is good enough if it is anywhere near the supposed current capacity rating. The research work in the development of fuses by standard manufacturers would have been wasted effort if this were true. The very definite requirements for the construction and safe operation of fuses as demanded by the Underwriters' Code and Underwriters' Laboratories' standards are based upon the knowledge that a proper fuse cannot be produced without careful manufacture and testing.

These rules are the result of years of study and experience which have shown fuse making to be both an art and a fairly exact science. Equivalent results cannot be obtained by the rough-and-ready means described by Mr. Rich, and as a fuse is essentially a protective device and usually the only one in a circuit, the unwisdom of attempting to refill fuses with so-called "fuse wire" should be self-evident. It is unfortunate that this fuse wire is sold as it is, marked, for instance, "tested 10-amp. fuse wire." Whether such wire will fuse at more or less than 10 amp. depends upon the length of the piece employed, the man-

ner of attachment to its terminals, the mass and surface of those terminals and the packing or filler, if any, surrounding it, to mention only the more important items. The performance on short circuit of a fuse refilled with such fuse wire or with other home-made elements is exceedingly doubtful. Experience has shown that changes in the fusible element far less radical than this will very often wholly alter the operation of a fuse and make it unsafe and unreliable.

In listing non-renewable fuses (one-time fuses) the Underwriters' Laboratories states that the manufacturers are prepared to refill them, marking and guaranteeing them as to ratings and operation upon the same basis as new fuses. Recognition of refilled fuses extends only to fuses thus refilled by their original manufacturers. Renewable fuses are approved only when used with renewal links made by the fuse manufacturer for his own particular casings. These limitations are made not to give business to the listed fuse makers, but because fuses refilled by others than real fuse experts are almost certainly hazardous.

The abuse of fuses constitutes perhaps the greatest evil and hazard in the present use of electricity and one which underwriters and municipal inspectors are unable to control with any great success. It is most unfortunate that the public, already too prone to disregard safety rules, should be encouraged by advice like that offered by Mr. Rich to practice a false economy at the expense of all reliability in the operation of fuses and at the risk of destroying the value of the sole protective device in electrical circuits.

Those who are disturbed by the reported large number of electrical fires and the resulting losses may well ask whether the abuse of fuses is not one of the prime causes and whether it is not very probable that fuses refilled as described in the article referred to are frequent causes of fire.

DANA PIERCE,
Vice-President.
Underwriters' Laboratories,
New York City.

[The ELECTRICAL WORLD agrees with Mr. Pierce's contention that safety is a paramount consideration in the fusing of circuits and welcomes the opportunity to say that it does not indorse the practice of refilling non-renewable fuses except under expert supervision such as is afforded by the fuse manufacturers.—EDITOR.]

Effect of Static Discharge on Telephone, Telegraph and Power Circuits

To the Editor of the ELECTRICAL WORLD:

SIR: On March 5, during an ordinary electrical storm, a violent electrical aërial discharge occurred at Kendalls, Wis. It had the results and characteristics of an explosion of dynamite or some other high explosive. At first it was thought a store of dynamite had exploded, but upon investigating it was found that the occurrence was entirely an electrical phenomenon. Unlike an ordinary electrical discharge, it was not concentrated at any point, but was distributed over quite an area. The concussion was so severe that in nearly every business building from two to sixteen window panes were shattered. A window was completely blown out of the Chicago & Northwestern depot.

Overhead circuits, such as telephone, telegraph and power lines, were nearly all affected. The telegraph circuits routed along the Chicago & Northwestern right-of-way were all grounded in air-gap protectors in the Northwestern station. The insulated copper ground wire between the protectors and ground connections was fused, several holes were blown through the insulation, and the molten copper metal was completely blown out of the insulating covering. Isolated parts of the telephone equipment used for train dispatching were burned and destroyed. The bottom of the cable box at the open-wire terminal, which is about 150 ft. from the station, was completely blown out, but otherwise box and equipment were uninjured.

Virtually all telephone circuits at Kendalls and its immediate vicinity were put out of service by this storm. The relays controlling the crossing bells on the Chicago & Northwestern Railway were burned so that the bells rang continuously, which added to the confusion. In the power house supplying electrical energy for the city of Kendalls the switches on the power board were twisted into irregular shapes and forms.

CHARLES T. REISZ.
Western Union Telegraph Company,
Chicago, Ill.

Influence of Iron on the Temperature Coefficient of Manganin

To the Editor of the ELECTRICAL WORLD:

SIR: The important bearing of iron on the temperature coefficient of manganin was first pointed out, so far as I am aware, by M. A. Hunter and J. W. Bacon.* Recently Dr. E. B. Rosa of the Bureau of Standards reported in this journal† that manganese between the limits from 9 to 13 per cent has no effect on the temperature coefficient of resistance, but that the presence of iron affects it to a considerable degree and up to 1 per cent improves the temperature coefficient of the resulting alloy.

The serious shortage of manganin caused by the war has caused great progress in the manufacture of manganin in Japan, and recently I have had opportunities to test several home-made samples. As the tested samples contain iron in much wider range than those reported by Dr. Rosa, it may be of interest to give a short account of my results.

To measure the temperature coefficient the wire was wound on a crossed mica frame and, after being thoroughly coated with shellac, was annealed by heating in an electric oven at 150 deg. C. for a period of fifteen hours. This process of annealing was found to be indispensable in order to obtain consistent temperature-resistance relations.

No parallelism between the iron content and the temperature coefficient of resistance was observed. This seems to be due to the influence of the larger amounts of nickel and manganese contained in the tested samples. It was found, however, that the presence of iron to an extent more than 1.5 per cent is harmful to the resulting alloy.

Commercially pure nickel and manganese, even the best samples, are rarely free from iron, so that there is little danger that the resulting alloy will contain too small an amount of iron. Hence in making manganin special care should be taken to make the iron content less than the amount just stated.

Owing to the large amount of nickel, the tested samples showed high thermo-electromotive force against copper, and the thermo-emf. is approximately proportional to the amount of nickel.

DR. JUICHI OBATA.
Electrotechnical Laboratory,
Department of Communications, Tokyo.

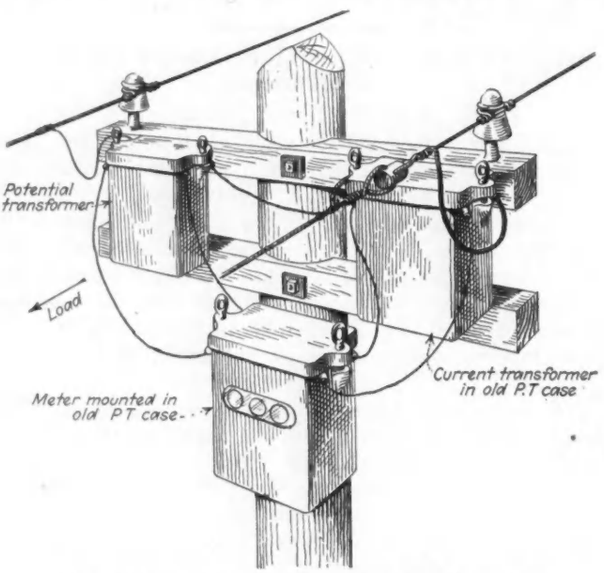
**Chemical and Metallurgical Engineering.* Vol. 21 (1919), p. 520.
†ELECTRICAL WORLD, Vol. 75 (1920), page 941.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

An Outdoor Meter Installation for Suburban Customers

SOME small, serviceable and inexpensive outdoor meter installations for single-phase, 2,300-volt lines were required recently by the meter department of the Empire District Electric Company at Joplin, Mo. City primaries had been extended at different points to supply suburban farmhouses, the farm consumers agreeing to stand the line and transformer losses by being metered at the town border. The following method was used with success:



INEXPENSIVE OUTDOOR METERING INSTALLATION

The cases and covers were obtained from two 2,000/100-volt discarded potential transformers. In front of one case and near the center a space equal approximately in size to that of a meter dial was drilled out and sealed with a glass plate from the inside. A 5-amp., 110-volt meter was prepared by removing the busbar on the middle terminals and then calibrating, particular care being taken with the light-load adjustment. This meter with the current and potential leads attached was fastened in the case by means of a bolt through the back of the case in such a position that the dial was opposite the glass-covered opening and thus could easily be read. The current leads were brought out of the case on one side through the original bushings, and the potential leads on the other side. In the second transformer case a 10-amp. to 5-amp. current transformer was placed with the primary leads entering the original primary bushings and the secondary leads coming out of the secondary bushings.

These cases with the addition of a 2,000/100-volt potential transformer were mounted on a pole top, as shown in the sketch. The potential transformer was placed on one side of the pole and the primary leads were tapped to the line wires. The case containing the current transformer was mounted on the opposite end of the same cross-arm, a guy (strain) insulator was inserted in the line wire on that side and the line was looped around it through the current transformer. The case with the meter was mounted in the center, and the current and potential leads attached thereto were connected to the proper secondaries leading from the potential and current transformers. Primary cut-outs are not shown in the sketch, but they were placed on the line side of the installation on the meter pole or on the preceding pole.

S. E. EVANS,
Foreman Meter Department.
Empire District Electric Company,
Joplin, Mo.

How a Boiler Room Can Improve Quality of Service

QUALITY of service from the consumer's viewpoint is judged by the outward physical signs of constant brilliancy of lamps, constant speed of motors, and freedom from interruption. The boiler room must do its share toward maintaining this quality. The first two conditions indicate constant voltage and unvarying speed of the prime mover—the former greatly dependent on the latter. Variation in speed of the prime mover—excluding that due to overload—may be due to several causes, all of which indicate inefficiency in operation. The cause may be governor trouble, and if so, can be easily remedied. In many cases it is due to fluctuating steam pressure. Assuming that boiler capacity is ample for the load to be carried, fluctuation in steam pressure may be due to poor firing, to improper regulation of air supply or to uneven supply of boiler-feed water. The first two causes are often the more difficult to remedy because of the poor grade of labor available for fire-room service. For this reason a greater responsibility for the economical use of fuel rests on those in charge of plant operation and makes closer boiler-room supervision imperative. The uneven supply of feed water can be remedied by the installation of feed-water regulators, of which there are many good types. An even supply of feed water results in feed water of even temperature, which means higher efficiency in boiler operation and more economical use of exhaust steam for heating the water, and in the case of condensing plants equipped with surface condensers avoids waste of condensate. The installation of a feed-water regulator is sometimes objected to because the fireman becomes dependent on it and its failure to work may result in damage. However, like every other boiler-plant auxiliary, the feed-water regulator needs careful attention for good operation.

The plant auxiliaries are little things on which the continuity of service often depends, and they should receive the same careful and frequent inspection as is

given to the main units. The exciters, boiler-feed pumps and hot-well pumps deserve careful consideration if continuous service is to be rendered. Their location in the plant is also of great importance; they should be easy of excess and whenever possible should be in plain view. If they are in dark or relatively inaccessible places, they will be neglected and may fail to operate at a critical moment.

C. A. GREENIDGE,
Chief Engineer.

J. G. White Management Corporation,
New York City.

Short Cut for Estimating Power of Waterwheel

A SHORT cut for determining approximately the horsepower developed by a waterwheel is the use of the formula Hp. $= qh/10$, where q is cubic feet of water per second and h is effective head in feet. In figuring possible power from waterwheels it is customary to use the formula: Hp. $= 62.5\ qhe/550$, in which 62.5 = weight in pounds of 1 cu.ft. of water; e = efficiency of wheel in per cent; 550 = foot-pounds per second necessary to produce 1 hp., and q and h are the same as in the first formula.

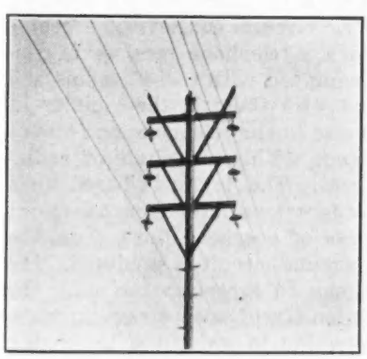
A few years ago efficiencies of 75 to 80 per cent were considered good, but today waterwheel manufacturers will guarantee 85, 90 and even 92 per cent, depending on conditions. Taking 88 per cent as a fair average, we can reduce the formula to Hp. $= qh/10$, which is shorter and simpler to use.

Thus for quick estimating simply multiply the flow by the head and point off one place. One setting on a slide rule will give a direct reading.

Berlin, N. H. RALPH MCKINNEY.

Extensions on Cross-Arm Braces Support Ground Wires

TO CONSTRUCT a distribution line requiring three overhead ground wires most cheaply, the Inspiration Copper Company, Inspiration, Ariz., makes use of an extension of the cross-arm braces supporting the upper cross-arm to carry two of the ground wires. As shown in the illustration, one of the ground wires is supported on the tops of the steel poles. The other two are placed almost directly above the line wires. More than one ground wire is needed in this installation because of the severity of the lightning, which occurs nearly every afternoon in summer time, and because the service from the generating station to the mine and mill can be allowed to suffer no preventable interruption. Although the line is operated at but 6,600 volts, yet it is insulated with standard suspension-type insulators rated at a much higher line voltage.



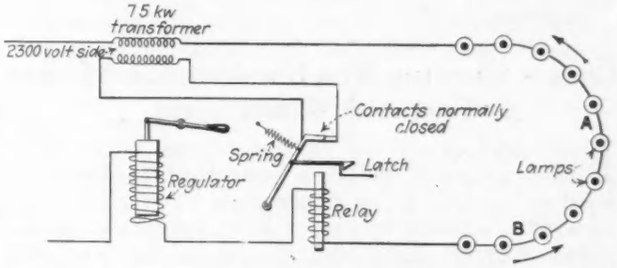
THREE GROUND WIRES MOUNTED IN AN ECONOMICAL MANNER

A. N. VOSS,
Electrical Engineer.

Inspiration Copper Company,
Inspiration, Ariz.

Street-Lamp Burn-Outs Prevented by Relay Scheme

AN INSTALLATION which has saved a large number of street incandescent lamps is in operation at a substation of the North Carolina Public Service Company, Salisbury, N. C. By this arrangement the 2,300-volt side of a transformer with the low side open is connected in series with the lamps when excessive current flows in the circuit. The necessity for this installation was brought about by the burning out of the street series lamps on one of the circuits controlled from this station, the circuit in question containing about 15 miles of No. 6 wire feeding twenty 100-cp., forty-one 80-cp. and fifty-six 60-cp. incandescent 6.6-amp. series lamps. No arc lamps are on this circuit. The station equipment consists of a regulator rated at twenty-five lights



WHEN CURRENT IN LAMP CIRCUIT BECOMES EXCESSIVE TRANSFORMER SECONDARY IS OPENED

(meaning arc lamps) and switchboard as shown by the diagram. On one occasion a cross with the secondary of a lighting transformer occurred at the point A and every lamp on the circuit from A back to the station in the direction shown by the arrow was burned out. On another occasion a cross occurred at B with the same result, this time all the lamps in the circuit from B back to the station in the direction of the arrow being burned out.

An analysis of the conditions showed that if this trouble was to be avoided in the future it was necessary to arrange to insert some high reactance in the line at the station in case of a cross or ground, whereas under normal operation this reactance would be cut out. It was decided to use for this reactance a 7½-kw. transformer rated at 2,300 volts primary and 350 volts secondary which had lain idle for several years. Recognizing the fact that the reactance of the primary of a transformer is high with the secondary open and low with short-circuited secondary, the transformer was installed with the primary in series with the arc line and the secondary wires were connected to the contact points of a home-made relay. This relay consists of a pull-up coil connected directly in the arc line, an armature and two contact points to which are connected the secondary leads of the transformer. Under normal current, which is 6.6 amp., the armature of the pull-up coil floats within the coil, guide rods having been arranged to hold it in place. With a sudden increase of current, say to 7 amp., this armature is quickly pulled up, tripping a latch which holds the contact points together and allowing the contacts to be separated by a spring, opening the secondary of the transformer and automatically inserting the high reactance of the primary in the arc line, thereby reducing the current to approximately 1 amp. When this happens the substation operator tries the line a second and third time and if trouble still exists the trouble department is notified.

The contacts have to be closed by hand, of course, this insuring that the operator shall know of any trouble.

In order to prove that the apparatus would take care of an extreme condition, the following test was made: With the circuit operating under normal conditions, with approximately 1,600 volts on the arc line, the entire external circuit with the exception of two lamps which operate normally on about 64 volts was shunted out, throwing the voltage of the entire circuit on these two lamps. The relay operated so quickly that they were not damaged in any way.

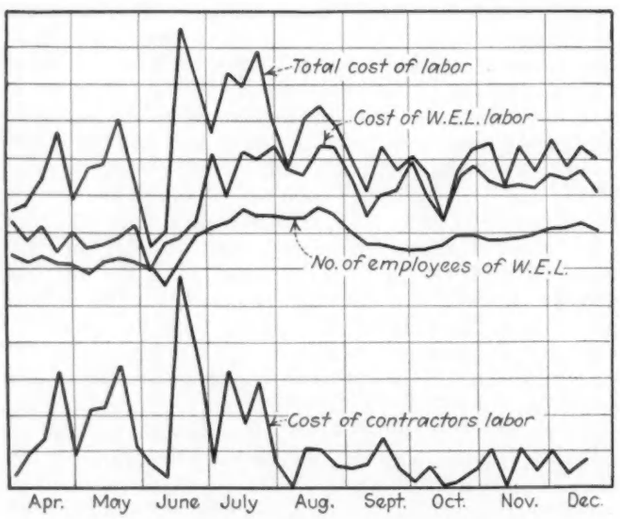
The credit for the design of this apparatus should be given to F. L. Bunker, Westinghouse Electric & Manufacturing Company, who supervised the construction. No trouble has been experienced from burned-out lamps due to crosses or grounds since the installation of the relay.

J. H. ROBERTSON,
North Carolina Public Service Co., Manager.
Salisbury, N. C.

Curves Showing Men Employed and Labor Cost Aid Management

FOR checking up the number of men employed to handle work in progress, correcting tendencies toward an oversupply or undersupply of workmen and showing at a glance the cost of labor, curves such as are shown herewith have been plotted by the Worcester (Mass.) Electric Light Company's distribution department. These curves, which are plotted from the weekly payroll, show the variation of the total cost of labor, the fluctuations in the labor employed by the company and in the labor of contractors, and also the number of employees in the department of the company concerned. If certain work is to be planned for the future, the number of men required and approximate cost can be estimated by consulting the chart records for such work done in the past.

The charts are used for aiding the management of this company in a number of ways. Some of them have



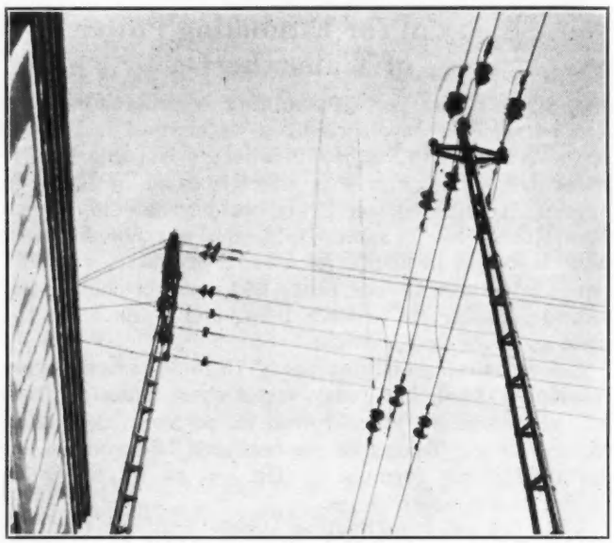
CURVES OF LABOR AND COST USEFUL FOR PLANNING FUTURE WORK

already been published in the ELECTRICAL WORLD (see issues for April 9, 16 and 23, 1921, and more will be published in issues to follow.

GEORGE M. HARDY,
Worcester Electric Light Co., Superintendent.
Worcester, Mass.

Corner Poles Placed So They Do Not Obstruct Sidewalk

NOT wishing to place a pole directly on the curb line on a busy corner in Phoenix, Ariz., the Central Arizona Power Company has made use of the corner construction illustrated herewith. The pole at the right is not at the curb line but some distance back from the corner. The one on the left is placed on the curb and building lines and is the dead-end pole of the line extending to the right. Thus neither of the poles interferes with the free use of the sidewalks. The two suspension-type insulators in each line wire were made up in the span before stringing, and the junction taps are placed on either side of the insulators.



SIDEWALK OBSTRUCTION AVOIDED BY USE OF AN EXTRA POLE

FIELD EDITOR ELECTRICAL WORLD.
San Francisco, Cal.

Current Leakages Detected by Receiver Connected to Metal Shoes

A DEVICE developed by a German firm for locating leakages from electric circuits consists of a couple of metal sandals, to which a telephone receiver is connected. The workman equipped with these sandals and walking over the ground with them in the vicinity of a leakage will notice a noise in the telephone on account of the difference of voltage within the circle of radiation of the ground current. The device is based upon the fact that the stray current radiates from the point of leakage, or, in the case of overhead lines, from the pole through which the ground circuit is produced. The device allows the workman to ascertain not only the direction but also the intensity of such stray currents, and by following the direction to which the increasing intensity points the location of the leakage can be found. Only when both feet rest on circles of equal voltage will the noise cease, a case which will hardly happen in practice. From the intensity of the noise the operator can also estimate the extent of the leakage. As the ground currents can attain a very considerable intensity in the case of high-tension lines, a rheostat may be inserted in the telephone circuit.

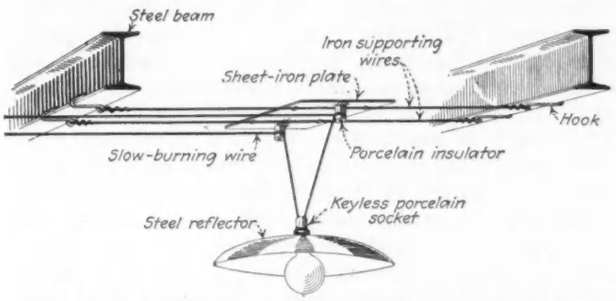
Berlin, Germany. H. O. HERZOG.

Industrial Applications

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Lamp Mounting Which Withstands High Temperature

FOR placing a lamp over a hot furnace or in other positions where the temperature is high a special construction must be used. In one foundry where it was necessary to mount a lamp over a long malleable-iron furnace the problem was solved by stretching two strong iron wires across overhead from one steel beam to another. In the middle of the span a thin sheet-iron



HEAT-PROOF CONSTRUCTION USED ABOVE A MALLEABLE-IRON FURNACE

plate 12 in. square was securely bolted. On this plate were fastened two porcelain insulators carrying the line of slow-burning wire, and a few inches below was suspended a porcelain keyless socket into which the slow-burning wire was connected. A 15-in. steel reflector was used with a 100-watt nitrogen lamp. The whole installation is proof against high temperature. It affords excellent illumination over the top of the furnace, which is charged and closed up early every morning and is opened after each day's work. H. S. RICH.

East Berlin, Conn.

Too Small a Pulley Caused Bearing to Burn Out

RECENTLY a case of repeated burn-outs of bearings on a motor was found after investigation to be caused by the use of a pulley with too small a diameter. The user was puzzled because the motor drove a shaft at the correct speed and the power delivered was under 30 hp., the motor rating. Moreover, the motor did not overheat, fail to start or misbehave itself in any of the usual ways. It did, however, burn out its bearings regularly about once a month. An investigation disclosed the fact that the pulley on the motor was 7 in. in diameter and the belt was 8 in. wide, while the speed of the motor given on the nameplate was 1,800 r.p.m. A reference to the rules of the Power Club and to manufacturers' bulletins showed that the standard diameter size of a pulley for a 30-hp., 1,800-r.p.m. motor is 9 in. and that the belt should be 7 in. wide.

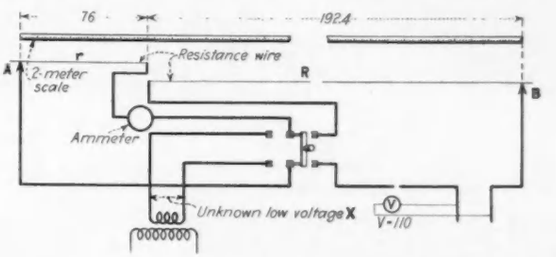
The cause of the trouble was of course apparent at once. The diameter of the pulley was too small. It is obvious that if the diameter of the pulley is reduced the speed of the belt will be less. This means that the net pull upon the belt must be increased in the same proportion so that the product of the speed and the pull will be constant. In this case the net tension of the belt was necessarily 30 per cent above the normal pull, and consequently the bearing was working under a continuous overload of 30 per cent. Actually the condition was much worse than this would indicate. Since the belt was insufficient for the service, it was necessary to stretch it very tightly in an attempt to prevent excessive slip.

Moreover, the line of pull of the belt was farther from the center of the bearings than it should have been, owing to the increased width of the belt. The actual overload on the bearings was nearly 50 per cent. The obvious cure was to use the proper size of pulley, which was a diameter of 9 in. with a belt 7 in. wide. This was impossible in this case since it would have been necessary to use a much larger pulley on the countershaft and there was not sufficient clearance between the shaft and the ceiling for the larger pulley. The only remedy was to replace the motor with one of the same horsepower operating at 1,200 r.p.m.

Howell Electric Motors Company, Howell, Mich. B. F. BAILEY, Chief Engineer.

Shop Method for Low-Voltage Measurement

IN AN industrial laboratory where 60-cycle alternating current is used it was necessary recently to measure accurately the low voltage obtained from small induction apparatus. As no low-reading alternating-current voltmeter to indicate from 1 volt to 10 volts was available, a shop method was developed. A circuit as shown in the diagram served for the purpose. *R*



ARRANGEMENT FOR MEASURING LOW VOLTAGE WITHOUT USING LOW-READING VOLTMETER

and *r* stand for variable resistances made up of carefully straightened nichrome wire, which is placed alongside a two-meter scale divided in centimeters. Using a low-reading ammeter and sliding contacts *A* and *B*, the apparatus is carefully adjusted, so as to

81.40

5612

have the same amperage upon closing the switch to either side.

When the switch is to the right the voltage across r is to the line voltage (V) as the length of r is to the length of $(r + R)$ (as they are in series), or $x/V = r/(r + R)$, where x is the unknown voltage. Now, if the switch is thrown to the left and the same current flows as before, then the voltage across r is the same as before. Consequently this voltage may be calculated from the formula just given. As a numerical example, suppose $V = 110$, $R = 192.4$ and $r = 7.6$. Then $x/110 = 7.6/200$, and, solving, $x = 4.18$ volts.

When the resistance wire is No. 32 B. & S. gage from 0.2 amp. to 0.3 amp. is the necessary current. As the tie wires are made up of comparatively large cord with soldered terminals, they have negligible resistance in comparison with the nichrome wire. As both resistors are of the same cross-section and at the same temperature, the resistance of each is proportional to its length.

Lima, Peru. V. M. ARANA,
Consulting Electrical Engineer.

Locating Battery Troubles with High-Rate Discharge Test

TO PICK out those cells of a battery which require treatment or repairs a high-rate discharge test is very valuable for application to the closed type of lead storage battery. The test consists of discharging the batteries at a fairly high rate and taking a voltage reading of each cell while discharging. A suitable current rate for this test is about nine times the four-hour rate of discharge, if the battery is rated for four hours, or sixteen times the eight-hour rate, if it is rated for eight-hour discharge. If the nameplate gives any other time of discharge, the current may be figured by comparison with the four-hour or eight-hour rate given. This current is held for about fifteen seconds, and then voltage readings are taken on individual cells with the current still flowing.

It is best to take a hydrometer reading of each cell before making the test. If the readings are within fifty points of each other and all are below 1,200, the battery probably needs a bench charge with adjustment of the strength of solution. If the readings are above 1.200 or one cell differs from the others by fifty points or more, the discharge test should be made. If the voltage readings on the test are within 0.1 volt of each other, the battery needs a charge with an adjustment of the strength of solutions, or maybe there is a leaky jar which should be replaced. If the voltage readings differ by 0.1 volt and the battery is pretty well charged, there is something internally wrong with the cell showing the low reading, provided that it has not been short-circuited while in service. This cell should be opened and examined. However, if the battery is discharged

TABLE II—CONDITION OF BATTERY AS INDICATED BY HYDROMETER READINGS

Hydrometer Readings	Condition of Battery
1.300 to 1.270	Fully charged
1.270 to 1.200	Above half charge
1.200 to 1.150	Below half charge
1.150 or less	Discharged

TABLE I—HIGH-RATE DISCHARGE TEST FOR LOCATING TROUBLES ON STORAGE BATTERIES

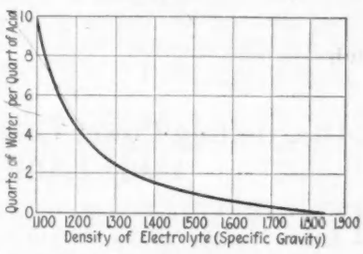
Gravity is read on each cell before starting discharge. Voltage is read while battery is discharging at a high rate, about nine times the four-hour rate or sixteen times the eight-hour rate. Current should flow fifteen seconds before taking voltage and should be flowing while readings are being taken.

Gravity Readings		Voltage Readings		Condition	Treatment
All readings within 50 points of each other	Above 1.300	Do not take		Electrolyte has probably been added	I. Give "water treatment," and then test. For water treatment empty electrolyte and fill cell with water. Charge at two-thirds normal four-hour rate or three-eighths of eight-hour rate, until gravity remains between 1.270 and 1.310 for three hours. If between 1.300 and 1.310 adjust strength of electrolyte to between 1.270 and 1.300. If gravity rises above 1.310, repeat the water treatment.
	1.270 to 1.300	All cells within 0.1 volt of each other	All above 1.75 volts	Good	II. None required.
			Highest below 1.75 volts	Electrolyte has probably been added	III. Give "water treatment" and test again. (See I.)
		One cell at least 0.1 volt lower than others	Any cell above 1.75 volts	Cell with low voltage has been externally short-circuited or is in internal trouble	IV. If cell has not been externally short-circuited, it should be opened and trouble removed.
			Highest below 1.75 volts	Entire battery needs charge or else is in internal trouble	V. Charge, test again, and, if same result, examine and remove trouble. For this charge remove cell from battery and charge at one-third of normal four-hour rate or one-fifth of eight-hour rate, until gravity reading is constant for three hours.
	Below 1.270*	Do not take		Probably not fully charged	VI. Charge to maximum gravity and voltage, adjust gravity to between 1.270 and 1.300, and then test. (See V.)
One cell at least 50 points lower than others	Highest above 1.300	Do not take		Electrolyte has probably been added	VII. Give "water treatment," and then test. (See III.)
	Highest 1.270 to 1.300	Do not take		Leaky jar; electrolyte spilled from low cell; low cell been externally short-circuited, or low cell is in trouble	VIII. Replace jar, if it leaks. Otherwise charge to maximum gravity and voltage, adjust gravity to between 1.270 and 1.300 and then test. (See V.)
	Highest below 1.270	Do not take		Probably not fully charged	IX. Charge to maximum gravity and voltage, adjust gravity to between 1.270 and 1.300 and then test. (See V.)

* An experienced man can make the voltage test with specific gravity as low as 1.200, using the same indications as given in this table for 1.270 to 1.300 gravity. Under 1.270 gravity, however, the 0.1-volt limit may become greater and the 1.75-volt limit may become lower, depending largely upon the state of charge. Only experience can guide, so it is deemed best to omit this condition from table.

the difference in voltage may be greater than 0.1 and yet not indicate any internal trouble. If there is any question, the battery should be put upon a bench charge and charged to maximum gravity and voltage and then for several hours more.

A bench charge is made at about one-third of the four-hour discharge rate. It is continued at this rate until all cells are gassing or bubbling freely and evenly and until the hydrometer readings and voltage are constant for five hours. The gravity on each cell should be between 1.270 and 1.300, for motive-power batteries and for batteries in starting, lighting and ignition service in temperate climates. In tropical climates "Exide" batteries in the latter service are specified to be operated with gravity about seventy points lower, *i.e.*, 1.200 to 1.230, fully charged. This gives better life and service with high temperatures. By tropical climates are meant those where freezing of water never occurs. If in this charge the hydrometer readings of any cells continue to rise above 1.310 give the "water treatment" as shown in Table I. In making this charge keep the temperature of the solution below 110 deg. Fahr., interrupting the charge if necessary.



PROPORTIONS OF WATER TO ACID OF 1.835 SPECIFIC GRAVITY FOR ELECTROLYTE OF DIFFERENT DENSITIES

For proportion by weight divide the above amounts of water by 1.835.

After making this charge the battery should have another high-discharge test and the voltage should be read on each cell. The accompanying table shows what conditions of voltage and gravity may be met and indicates what troubles are present, if any, and how to remedy those troubles.

If it is necessary to change the density of electrolyte, acid stronger than 1.300 should not be added directly to the cells. The electrolyte should be mixed in glass, earthenware or rubber vessels. In mixing, the water should be poured in first and the acid added in order to prevent danger of the acid heating excessively and being thrown out of the vessel. Extreme care should be taken that no impurities get into the electrolyte and that it does not come in contact with metal surfaces. The proportions of acid and water to mix for different densities of electrolyte are shown in the curve reproduced herewith. For a gravity of 1.280, which is the value usually employed for filling charged cells, 2.75 quarts of water must be used to 1 quart of acid of 1.835 specific gravity.

Electric Storage Battery Co., RALPH W. RITTER,
Philadelphia, Pa. Engineer, Operating Department.

Enlarging Air Gaps for Heavy-Duty Motors

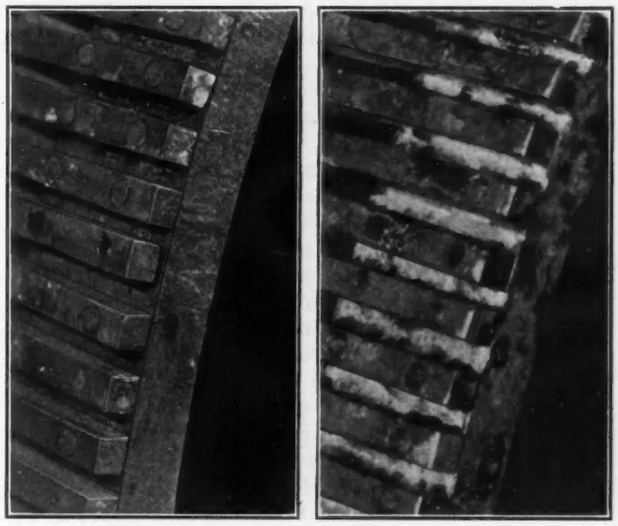
IN HEAVY-DUTY service in some of the copper mines and mills of Arizona it has been found desirable to enlarge the air gaps of induction motors to give considerably greater clearance between the rotors and the stators. In one particular case the air gap of a 500-hp., 440-volt induction motor had its rotor turned down so as to increase the air gap approximately 0.05 in.

Bearings of motors in such service generally receive a daily inspection and oiling. Often each motor is blown out daily, but, as the dust conditions are severe in the extreme, it is very difficult to keep the dust out of the bearings. This causes rapid wear. Although it is customary in the better supervised installations to gage the rotors weekly, yet service requirements sometimes prevent rebabbitting until damage has been done by rubbing between rotor and stator. No marked effect on the performance of the motors has been reported as a result of turning-down the rotors.

FIELD EDITOR ELECTRICAL WORLD.
San Francisco, Cal.

Welding Loose End Rings on Squirrel-Cage Rotors

FOR repairing defective rotors of squirrel-cage motors of the older types the latest reliable practice consists in welding the bars to the rings without reinsulating. This makes a permanent job and is a quick method for remedying a trouble frequently met, one which occurs in nearly all of the earlier designs of rotors. In one familiar type the bars are insulated and are secured to the end rings with bolts, nuts and lock washers. Another old type, familiar especially to repair-shop men, also has insulated bars, and the end rings are made up of a number of plates which are pressed on the ends of the bars and soldered. There are numerous other types which are similar in construction, on all of which considerable trouble has been experienced. Heavy loads heat up the end rings sufficiently to cause the metal of the bars and rings to expand, and when the load is removed or the motor is shut down contraction takes place. During the periods of expansion and contraction of the bolted-bar type oxidation takes place at the point of contact and the steel lock washers lose their temper, causing the bolts to loosen. This creates very poor contact between the bars and rings, raising the temperature of the latter



WELDING THE END RINGS OF A ROTOR GIVES A QUICK AND LASTING JOB

Left — Rotor for a 150-hp., 2,300-volt, three-phase, 60-cycle, 435-r.p.m. motor, showing the screws missing in one bar and the bar raised up from the ring.

Right—Defective bar is firmly welded to the ring. It was not found necessary to cement this rotor, owing to the fact that the cage winding was sufficiently tight in the slots not to be affected by vibration in service, as is very often the case with the larger-sized rotors.

to such an extent that the fishpaper insulation around the bars becomes charred and brittle, finally breaking off and flying out of the slots, leaving the bars bare and causing the complete cage winding to become loose in the slots, with a tendency to rattle while the motor is in service. In the rotor with pressed-on end rings temperature rise due to overload and similar conditions causes the solder to melt and be thrown out by centrifugal force.

When trouble of this character develops, the welding method makes a good and everlasting job. First, all excess grease and dirt is cleaned from the bars and rings at the point of contact and the under side of the ring is preheated to a bright red heat by a gas flame with forced air pressure. The bars are then welded on by melting a ⅛-in. stick of "Tobin" bronze dipped in special brazing flux on the spot to be brazed by means of an oxyacetylene flame. A fillet weld is made between the bars and the ring.

The person doing the job should be careful not to deposit more metal than is necessary to secure the bars firmly to the rings. The result will be less metal to remove from the ring after the job is finished and incidentally less waste.

This method applies only to end rings with a good mixture of copper or other metal which has a fairly high melting point. In the case of rotors with high-resistance end rings, used for elevator service, etc., bronze brazing must not be attempted on account of the low melting point of this metal, as it actually fuses in some cases before the proper preheating temperature can be reached. A very good job is made on this type of rotor by soldering with silver alloy dipped in borax and applying just enough heat to cause the alloy to run freely in and around all crevices between the bars and rings.

Owing to the heat, virtually no insulation is left around the bars, which leaves the cage grounded to the core. No effort is made to clear the ground, as it has been found that insulation is not necessary, the current induced in the winding naturally following the path of least resistance. The winding is made of a much better conducting material than iron and has sufficient cross-section to take care of the proper distribution of the secondary current.

Since there is no insulation left around the bars, the cage winding is free to vibrate in the slots. This is remedied by the application of a suitable cement immediately after welding and while the core is still hot. The cement is mixed to a consistency such that when it is applied with a putty knife it can easily work its way well down in the slot along both sides of the bars. When cold the cement hardens so that the winding is firmly secured. The cement is not affected by moisture or oil, but in the course of a year or so recementing may be necessary owing to expansion and contraction of the bars. If recementing is again found necessary—and it is a very simple and inexpensive job—the time required to put the rotor back in service is reduced to a minimum as compared with the older method of reinsulating, etc.

After cementing the end rings are trued up in a lathe to remove any excess welding or soldering metal prior to placing the rotor in the motor frame. The motor should then receive a free running test, being started in the regular way and a close watch made to ascertain the time required to reach full speed. If full speed is not attained in a reasonable length of time, then the starting torque has been decreased owing to an increase in cross-section of the end rings caused by depositing too much welding metal. To remedy this the rotor is placed in a lathe and a cut taken off the outside end of each ring, the amount of metal to be removed depending upon how much the resistance was decreased. Through experience on several jobs and good judgment the operator will be capable of doing the work with such a degree of accuracy that only one finished cut will be necessary to make the rotor ready for operating service.

E. R. DEBMAN.

East Orange, N. J.

Distributing Power Costs in a Pulp Mill Using 1,500 Hp.

BY CAREFULLY compiling a monthly cost sheet showing the power distribution it has been found feasible to apply the cost of energy to the cost per ton of finished product, as well as the cost for various departments, in the pulp mill of the Provincial Paper Mills at Port Arthur, Ontario. While the mill manufactures only one product, sulphite pulp, and while the cost of power is really charged to one article, it is not charged as overhead, as is often the case in many plants, but is distributed between the different departments as a part of the manufacturing cost. There are, however, three different grades of pulp made, and the costs of power are carried to the point where electrical energy consumption can be applied to each of these different processes.

POWER COSTS FOR A TYPICAL MONTH

Previously estimated maximum demand, 945 kw. = 1,265 hp.
Minimum, 75 per cent, or 708 kw. = 948 hp.

Power service for the month of February:	
Maximum demand, kw.	925
Transformer losses, kw.	15
Total maximum demand, kw.	*940
Present meter reading, kw.-hr.	22,700
Previous meter reading, kw.-hr.	469,100
Consumption, kw.-hr.	353,600
Transformer losses, kw.-hr.	6,720
Total consumption, kw.-hr.	360,320
Service rate, $1 per month per hp, or 1,260 hp =	$1,260.00
Consumption rates:	
(1) All consumption up to the first fifty hour monthly, 940 × 50 = 47,000 kw.-hr., at 1.75 cents	822.50
(2) All additional consumption up to the second fifty hours monthly, 940 × 50 = 47,000 kw.-hr., at 1 cent	470.00
(3) For all excess consumption, 360,320 — 47,000 — 47,000 = 266,320 kw.-hr. at 1 cent	266.32
Total	$2 818.82
High-tension discount, 15 per cent	422.82
Balance	$2,396.00
Prompt payment discount of 10 per cent	239.60
Balance	$2,156.40

*Equivalent to 1,260 hp.

Power is purchased on a basis of $1 per horsepower per month and figured on the maximum ten-minute demand, including transformer losses. The energy charge is on a sliding scale, the first fifty hours of the total maximum demand being charged for at the rate of 1¾ cents per kilowatt-hour, the second fifty hours of the total maximum demand being at the rate of 1 cent per kilowatt-hour, while all in excess of these two rates is charged for at 0.1 cent per kilowatt-hour. As this company owns its substation apparatus a high-tension discount of 15 per cent is allowed, and an additional 10 per cent, as is quite frequently the case in power contracts, is allowed for prompt payment. The rate for the succeeding months is not charged at the previous month's maximum demand, but is 75 per cent of it.

The connected load in this mill is about 1,500 hp.

and divided into eight main departments.* Each of these departments is fed from a separate panel in the substation, equipped with an ammeter the readings of which are taken every hour. The average of these readings taken for the month and the percentage of the total consumption is kept in the station log and transferred to the monthly substation report, as shown in the accompanying illustration.

The method of distributing the actual cost to the various departments is to determine first the total kilowatt-hour consumption, which is taken from the integrating kilowatt-hour meter, and then determine the maximum demand from the graphic wattmeter. The total power bill for the month of February, 1921, figured on this general basis, is shown in accompanying table on page 1000.

It will be noted that the total bill amounted to $2,156.40. By referring to the departmental percentages on the monthly substation report it is possible to divide this total up and apply the power costs to the individual departments. By using the general percentages given on the monthly substation report the

MONTHLY SUBSTATION REPORT

February, 1921.

Dep't	Department	Connected Load H. P.	Adopt.	Max Demand K. W.	Demand Factor	Load Factor	Plant Factor	Power Factor	Voltage	Kilowatt-hours	Power Cost
	Boiler House	25	15							1	21.56
	Yard	85	60							7	150.96
	Wood Room	390	220							22	474.40
	B.P. and Digester	180	200							15	323.66
	Pierch	233	200							22	474.40
	Screens	300	250							25	539.10
	Acid Plant	80	70							4	86.26
	Machine Room	35	30							2	43.13
	Lighting	35	35							2	43.13
	Total	1423	1200	.940	.88	.57	.90	.95	500	100	2156.40

Operators 3 Trouble of any sort, 213 hrs. Feb. 7 3 Hrs. 52 Min.

Cause of trouble Low Voltage Main drive belt to screens broken.

Remarks: Average Power 536 KW = 718 HP Present Meter Reading 13422700 KWH

Maximum Demand 925 KW Previous " " 13 69100 " "

Transformer Losses 15 KW Consumption 353600 " "

Transformer Losses 6730

Total Max. demand 940 KW = 1260 HP Total Consumption 360330 " "

Foreman.

MONTHLY COST SHEET ELECTRICAL DEPT.

OPERATION AND MAINTENANCE

Date February, 1921. DISTRIBUTION

ITEM	Wood Room	Yard	Steam Mains	Screen Room Bel's and Chutes	Digester and Blow Pits	Acid Tower	Machine and Screen	TOTALS
Power Cost	Yard 19.96 W.R. 474.40	21.56		Bleach 474.40 Screen 539.10	Digester 80.84 B.P. 242.66	86.26	43.13	2113.27
Light Cost	Yard 17.25 W.R. 4.31	4.32		Bleach 4.31 Screen 4.31	Digester 2.16 B.P. 2.16	2.15	2.17	43.13
Motor Repairs	Yard W.R. 1.13			Bleach 18.75 Screen	Digester B.P.			19.87
Light Repairs	Yard 12.17 W.R. 3.04	21.58		Bleach 12.60 Screen 13.18	Digester 11.39 B.P. .19	3.84	4.16	84.74
Miscellaneous	Yard 2.54 W.R. 2.54	2.54		Bleach 2.54 Screen 2.54	Digester 2.54 B.P. 2.54	2.54	2.54	22.86
Operators Salaries	Yard 44.00 W.R. 44.00			Bleach 88.00 Screen 88.00	Digester 22.00 B.P. 22.00	22.00	66.00	396.00
Repairmans Salaries	Yard 9.18 W.R. 18.84			Bleach 10.80 Screen 12.60	Digester 6.00 B.P. 6.30	16.16	21.20	194.18
Foremans Salaries	Yard 20.00 W.R. 20.00	10.00		Bleach 40.00 Screen 40.00	Digester 20.00 B.P. 20.00	5.00	5.00	660.00
Totals		824.35	60.00	1448.72	443.33	137.85	144.20	3978.55

Remarks: Cost per month HP only ave. 2156.40 ÷ 718 = 3.00 Total 2156.40 ÷ 1423 = $1.56

" " " " with maintenance added ave. 3978.55 ÷ 718 =$4.27 total 3978.55 ÷ 1423 =$2.16

Cost per ton for bleached production 5474.40 ÷ 574.5 = 84¢

" " " " total " 2156.40 ÷ 793.7 = $2.72

" " " " " with maintenance added 3978.55÷ 793.7 = $3.88

" " " " Screening production 882.70 ÷ 88 = 97%

Foreman.

POWER DISTRIBUTION RECORDS THAT FURNISH AN ACCURATE CHECK ON DEPARTMENTAL AND PRODUCTION COSTS

costs are further subdivided and analyzed on the monthly cost sheet for the electrical department. On this record the cost of operation and maintenance are also added, so that the total cost of operating the electrical department may be determined. From these figures it will be noted that the cost per horsepower for the average load was $1.56 without including maintenance, while with maintenance added the cost was $2.16. The cost per ton for the bleached production was 84 cents, while the cost for the total production was $2.72 per ton. With maintenance added the cost per ton for the total production becomes $3.88.

A copy of all of these reports is sent to the accounting department each month, and at the end of the year the records are all placed on a yearly chart (not shown) which indicates the maximum demand for each day. Another chart is also kept which covers the monthly maximum demand, the monthly connected loads, the average monthly power and the average yearly power. In addition the various costs are shown.

This method of charging costs has been entirely satisfactory, as it is possible to determine any unusual departmental condition or production expenses at a glance. The annual load charts show the monthly variations of conditions.

H. E. STAFFORD,
Electrical Engineer.

Provincial Paper Mills, Ltd.,
Port Arthur, Ont.

*The load requirements for this mill were analyzed in an article in the Jan. 29 issue of the ELECTRICAL WORLD, page 265.

Obtaining Good Performance from Electric Drills

IN OBTAINING the best performance from an electric drill the feed pressure is a very important factor. The feed pressure required for drilling in steel to the full capacity of the tool is greater than can be exerted by hand for all except the smallest sizes, and even in the small sizes made by the leaders of the industry there is enough power to operate the drill under all the pressure a heavy man can exert. A pressure of 500 lb. is seldom too much for a ½-in. machine drilling in steel. A feed screw is therefore usually supplied with the larger sizes. All reputable tools of this type have enough power to prevent stalling except under accidental circumstances. When this does happen through bending a drill or other accident the power should be cut off as soon as possible. Momentary stalling of this kind will not injure a well-designed machine. The part most apt to fail under these circumstances is the switch, which must then act like a circuit breaker.

Sometimes when drilling sheet metal the lip of the drill will catch as it breaks through, stalling the machine. This trouble can be prevented by grinding the drill especially for this work. The angle of the point should be reduced to give a longer point—59 deg. is the standard angle—and the sharp angle at the cutting edge should be ground off slightly to give the same result as a smaller angle of the spiral flute to the axis of the drill. This latter procedure alone may also help to prevent "grabbing" in soft material and will allow high-feed pressures without chipping the cutting edges in very hard material. For drilling in wood the type of drill will depend upon the condition and kind of wood and the depth of the hole. Very deep holes require the ship auger. When drilling green wood the hole should be cleared several times if the depth of the hole is many times the diameter. Choosing and conditioning the drill is important and can best be solved by the mechanic on the job.

Van Dorn Electric Tool Company,
Cleveland, Ohio.

E. L. CONNELL,
Chief Engineer.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

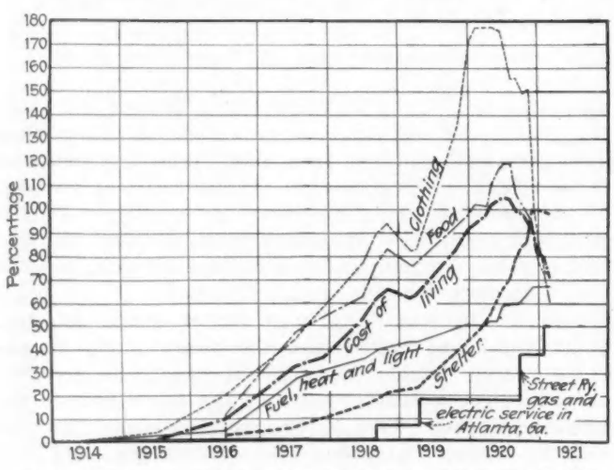
Profitable Increase in Business of Small Utility

AN INCREASE of slightly more than 20 per cent in the number of customers of the Albuquerque (N. M.) Gas & Electric Company was achieved in 1920. At the beginning of the year the total number of customers was 3,159. To these were added 678. This was done at a very low cost by soliciting business only along existing lines. The total average cost per consumer, including the sales expense, which was small, equaled almost exactly $50. An additional gross revenue of $9,168 resulted. At the beginning of the year the 1,725-kw. steam generating plant was carrying a load of 1,250 kw. At the end of the year the peak load was 1,500 kw. The output for the year was 4,684,000 kw.-hr., an increase of 849,700 kw.-hr. over 1919.

Increased Cost of Living Compared with Public Utility Rates

SHOWING that the increases in rates for electric, street railway and gas service have been extremely small compared with the increases of other items in the cost of living, the Georgia Railway & Power Company, Atlanta, Ga., recently inclosed an interesting folder with the monthly bills sent to over 40,000 of its customers. Attention was called to the comparison as follows:

"The accompanying chart shows the percentages of



COMPARISON OF PUBLIC UTILITY RATES AND COST OF LIVING

increase over pre-war levels in the price of the various items in the family budget. The combined effect of these items represents the 'cost of living' as indicated by the 'cost of living' curve on the chart.

"The percentages of increase in the combined cost of street-railway, gas and electric service has been insignificant compared to a great many items, and less than any other item in the family budget. It has remained at the bottom of the list.

"Prior to Sept. 1, 1918, notwithstanding that the price of practically everything else had soared and was still soaring, there had been no increase whatever in the charge for services furnished by the Georgia Railway & Power Company, although there had been a very great increase in the cost to the power company of furnishing such services."

Communities Are Judged by Their Utilities

FOLLOWING up the national campaign for public utility good will the Arkansas Light & Power Company of Pine Bluff, Ark., is running a series of advertisements in eleven local newspapers published in the thirty-three different communities served by the company. Showing how closely related are the interests of the community and the utility one of the advertisements placed the company's problem before the public in the following manner:

"Every community is known and judged by its utilities, and the public's attitude toward them. Good lights, abundant power, good transportation tell a stranger within the gates more about a city than can the spoken word. And the attitude of the public toward the utilities impresses the stranger favorably or unfavorably, because he realizes that a city is no better than its utilities. For, after all, the responsibility is with the people. If they are fair toward utilities, they enjoy good service; if unfair, the utilities cannot serve properly.

"Where the service of utilities is not efficient, experience warrants the deduction that some influence is at work which lessens the desirability of that community as a place of residence and occupation; a good place not to invest money; a good place to stay away from. For the stranger appreciates that a utility, like any other business, has its incentive to develop in the fact that it is prosperous.

"The electric light and power, telephone and telegraph, and electric railway services originated from the minds of inventive Americans. Here they have made greatest progress in development, American public services being the envy of the world.

"Although the public utilities have come into general usage within the life-time of the man still in his forties, they have become everyday necessities of modern life. Weaken them or derange them, and the whole nation is thrown out of gear. Wherever electric railway, electric light and power, and other public service has been suspended because of inadequate rates or other reason, social, commercial and industrial activities first slacken and then stop. And then decay sets in.

"If it is necessary for this property to be expanded—electric and power lines to be extended, street car lines to be built—in order to meet the public demand for service, the same thing must be done as when sidewalks are built or sewers installed.

"The utility must go out and get the money to buy the material and pay for the labor. This is because the utility is not permitted to earn enough to put aside a reserve for building extensions. It is in the same position as the city which goes into a bank to borrow money. If its credit is good it gets a loan; if it isn't it doesn't. It is just the same with the utility. If new additions to plant and extension of facilities are required to keep pace with the city's growth, the utility has to go out and sell securities. If it cannot show that it is entitled to credit because of its financial soundness, or because the public it serves is inclined to be unfair by trying to get service below cost and by mulcting the utility at every opportunity, then the utility doesn't get the money. The result is the extension isn't built, some people are deprived of service and community growth is stifled."

Breaking of Rate Contracts with Municipalities Justified

A PAMPHLET on "Rate Contracts Between Municipalities and Utilities," prepared by Walter A. Shaw, until recently a member of the Illinois State Utilities Commission, and giving an exhaustive review of the situation as it exists in Illinois, is being distributed by the Illinois Committee on Public Utility Information. In his booklet Mr. Shaw justifies the practice of state utility commissions in breaking contracts between municipalities and utilities wherever such action is necessary to establish fair and reasonable rates.

"The fact," Mr. Shaw says, "is that state commissions were created for the very purpose of breaking so-called contract ordinances. That part of the public which now accuses the commission of being 'contract breakers' is responsible for obtaining decisions from various state courts and the United States courts that rates prescribed in these ordinances must be set aside when it is determined that those so fixed are unjust, unreasonable, insufficient or excessive. The cities were the first 'contract breakers.'"

Using Illinois examples solely, Mr. Shaw reaches the conclusion that, inasmuch as municipalities began as far back as 1882 to invoke the courts in order to set aside alleged unfair contract ordinances and were upheld in their stand, they now can have no ground on which to resort to the courts in an effort to uphold contract ordinances when the advantage is on the other side. Another conclusion at which he arrives is that at no time were municipalities in Illinois either explicitly or implicitly given the power by the state to make a valid contract concerning rates to be charged by a public utility. He points out that Illinois was the first state to settle this question and that that decision has since been upheld by a United States court, which declared that such power of regulation of public utilities was inherent only in the state.

In distributing the pamphlet, the Committee on Public Utility Information calls attention to the fact that utility operators generally know the truth of the situation, but that the public is ignorant of it and must to a great extent rely upon the utterance of some agitator, either misinformed or purposely deceitful. To correct this condition the committee has suggested that the utility men call the pamphlet to the attention of mayors, councilmen, commercial clubs, city attorneys, judges and civic leaders, and others who attempt the discussion of rate contracts or commission regulation.

Achievements of Illinois Committee on Public Utility Information

TWO years' intensive effort on the part of the Illinois Committee on Public Utility Information to cultivate public good will for the industry has produced some surprising results. The committee closed its second year of activity this month, and even the most casual survey of its activities reveals amazing evidence of what can be done in this field by intelligent, practical planning consistently and persistently followed up under the direction of experts.

The purpose of the committee from its inception, to use its own words, has been "to conduct a systematic campaign for informing the public on the fundamentals, and particularly the economics, of the public utility industry, and thereby endeavor to cultivate a public opinion friendlier both to the industry and to the individual electric, gas, street railway and telephone companies." It utilizes all possible agencies for getting the case of the utilities before the public. It relies mainly upon newspapers, but it has also developed systematic utilization of other agencies, including public speakers, pamphlet literature and the public schools.

The committee celebrates its second anniversary by passing the five-million mark in pieces of literature distributed. These 5,000,000 pieces of literature have not been merely scattered broadcast, but have been definitely placed—each piece—in somebody's hands; and each piece was specially prepared or selected and approved by hard-headed practical utility men to be helpful to the utility industry.

This literature has gone to the general public by republication in newspapers and by other usual channels. Special pieces of it have gone directly into the hands of customers of public utilities, business men (members of chambers of commerce and other associations), bankers, lawyers, employers (for their employees), teachers, preachers, librarians, students in colleges and high schools, mayors, members of city councils and village boards, public officials of all kinds and candidates for public office.

AN INCENTIVE TO OTHER STATES

The scope and effects of what the Illinois committee has done and is doing are by no means confined to Illinois. It has helped organize and start similar educational campaigns in nine other states—Indiana, Kentucky, Ohio, Nebraska, Missouri, Oklahoma, Arkansas, Wisconsin and Michigan—and has inspired the preliminary steps in Iowa, Texas, California, New York, Kansas, Oregon and Georgia. Its newspaper material and all of its literature are available for use in other states for the asking or the taking and are extensively so used. Its speakers' bulletins, school pamphlets and other publications have been circulated from coast to coast.

In addition to its directly educational work, the committee has established and standardized itself as an information committee. Its informational help is constantly sought—and from all parts of the country—by newspapers wanting data pertinent to current news, by high school and college students facing a debate or a thesis, by lecturers wanting to freshen up platform material, by writers of circular, publicity and advertising matter for investment houses, and so on. Even members and employees of the state public utilities commission have drawn upon the committee's resources.

A noteworthy fact is that the committee has not once been seriously accused, by newspaper, politician or utility baiter, of trying to "propagandize" the public. This absence of hostility, as well as much of the committee's success in getting its educational matter accepted and printed, is attributed to its strictness in living up to the "information" part of its name.

AVERTING "HOME RULE"

In the summer of 1920 Chicago and Illinois politicians seized upon the rate increases granted by the public utilities commission as vote catchers. Violent anti-utility proposals were made in the campaign for the nomination and election of the present state administration. Repeal of the public utilities law, abolition of the commission and reversion to "home rule" regulation were threatened and were recommended in the Governor's inaugural address. Citizens and civic bodies then began to take notice. The Illinois Chamber of Commerce (a federation of chambers of commerce in the leading cities) conducted a referendum on the subject, and business men of the state declared for retention of the public utilities law and the commission by a vote of 21,825 to 1,039—a ratio of twenty-one to one. Talk of abolishing the commission or seriously changing the utilities law has declined.

While it is impossible here to record a full account of all that the Illinois Committee on Public Utility Information has done, the "high spots" in its routine may be summarized as follows:

A weekly news bulletin goes regularly to the 900 newspapers in the state—about 125 dailies. Special bulletins go to the dailies and press associations when news warrants it. This news service is intended to be informative rather than argumentative, to avoid the political and the controversial, to carry matter that is at once helpful to the utilities and interesting enough to be printed for its own sake.

FRIENDLY ATTITUDE OF PRESS

Use of this matter by the state press averages about 5,000 column-inches per month, equivalent to considerably more than 250 newspaper columns per month—more than 3,000 columns per year. Newspapers that were unfriendly have become friendly. Helpful editorials have appeared in the state press, literally by hundreds, where formerly there were hostile ones or none.

Speakers' bulletins have been issued, each devoted to some phase of the utility industry, as, for example, the nature, development and service of public utilities, the prosperity of communities and of public utilities, the history and philosophy of regulation by state commission, utility service rate making, and so on. These furnish any intelligent person with ample material for sound talks, and as a further guide each bulletin carries one or two sample speeches.

ENGAGEMENTS FOR PUBLIC SPEAKERS

A bureau is operated to find engagements, before clubs, civic associations, and so on, for dependable speakers on utility subjects. The bureau is also organizing local utility managers, city by city, into local committees to promote discussion of utility subjects in public meetings and otherwise. Local managers have been thus brought together for definite co-operation in nearly a hundred communities.

More than 800 Illinois high schools use specially prepared utility industry literature in classrooms, in theme work and in debating societies. This literature is, of course, 100 per cent informative, not one-sided propaganda, and is sent to high-school principals and teachers only on request.

All local managers of gas, electric, telephone and traction companies are on the committee's mailing list. By letter, by discussion at association meetings and by reminders from higher executives local managers are constantly asked to co-operate with one another and with the committee in all possible ways and particularly as follows:

1. To familiarize themselves with each weekly news bulletin (which they receive one day earlier than editors do), to discuss the contents of the bulletin with the local editor on every opportune occasion and to point out the application of general information in the bulletins to some local situation or question.
2. To get utility subjects discussed before clubs and civic organizations by themselves or other dependable speakers, the speakers' bulletins aforementioned being always available for speech material.
3. To tie in with the committee's work in the schools by getting high-school classes to visit utility company plants, by stimulating debates and essay-writing competition, and so on.
4. To guide the committee in systematic distribution of helpful literature in their respective communities, with a view to getting maximum benefit from it.

ORGANIZATION OF THE COMMITTEE'S PERSONNEL

Samuel Insull is the "author" of the Illinois Committee on Public Utility Information. He conceived the general scheme and told a group of "Insull" company executives to "get something started." Thus it was that, with the co-operation of both Bell and independent telephone interests, the original membership of the committee in April, 1919, came to be as follows: John F. Gilchrist (chairman), vice-president Commonwealth Edison Company; Martin J. Insull, vice-president Middle West Utilities Company (now president of N. E. L. A.); Charles A. Munroe, vice-president Public Service Company of Northern Illinois and People's Gas Light & Coke Company (now president of American Gas Association); Britton I. Budd, president Chicago Elevated Railways (now vice-president American Electric Railway Association); Bernard J. Mullaney, manager public relations department, People's Gas Light & Coke Company; Clifford Arrick, publicity manager Chicago (now Illinois Bell) Telephone Company, and W. S. Vivian, secretary-treasurer United States Independent Telephone Association. Virtually every electric, gas, electric railway and telephone company in the state is now co-operating and is represented on the enlarged committee through members designated by the several state electric, gas, electric railway and telephone associations.

The committee's work was organized and is still guided by Mr. Mullaney as director and H. M. Lytle, former financial editor of the Chicago *Record-Herald*, as associate director. Out of the experience of all concerned in this Illinois campaign have come certain definite conclusions in relation to work of this character, among them the conviction that two important factors in the committee's success have been (1) the careful way in which its work is done so that no accusation may lie against it of trying to mislead the public, and (2) the motive power supplied by the weekly meetings of the committee and the facilities of the committee members for getting close to local managers and spurring them to co-operative action.

Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Progress in the Manufacture of High-Voltage Alternating-Current Windings.—W. ZEDERBOHM.—A detailed, well-illustrated description of the development of high-voltage motor, generator and regulator windings during the last twenty years. It was recognized early that round wires, wound at random, do not withstand over-voltage stress as well as rectangular conductors which fill out a given slot without leaving any dangerous air pockets. The author points to the great danger resulting from slow discharges, beginning at about 1,400 volts and destroying rapidly cotton covering which is not specially treated. Asphalt treatment and inclosing the coils in sleeves of "Mikanite" improve conditions materially. This method was standardized by the Siemens-Schuckert Works for all machines above 30 kw. and 1,200 volts. The entrance and exit slot coils now receive heavier insulation than all the other coils of the same winding (about 10 per cent of the number of turns are reinforced) to withstand line surges. Coils are wound on adjustable mandrels, are bent to the desired shape and smoothed out in steam-heated presses. If slots are wide enough the finished coils are laid in and the slots are closed by wedges. For machines with narrow openings of the slots the formed and finished coils are cut open again, straightened out at one end and threaded through the slots. By means of a small portable welding transformer the open ends are then closed again.—*Siemens Zeitschrift*, February, 1921.

Number of Bars and Torque of Squirrel-Cage Armatures.—W. STIEL.—Very elaborate tests were made to determine the influence of the number of copper bars in a cage armature upon the torque. One three-phase, four-pole, 1-hp. stator was successively tested with eleven different rotors, each having a different number of bars, varying from eighteen to forty-two. A spring dynamometer was used to trace out the torque curve, the motor driving a flywheel in all cases. The results showed that it is always advisable to have fewer slots in the rotor than in the stator, but that the difference should be small. The number of rotor slots should be even and divisible by the number of poles. The tests proved further that one may find in literature on this subject many statements contrary to practical experience. The influence of the form factor of the feeding voltage and the overfield caused by the stair-case form of the field curve are usually overestimated, while the influence of the change of the field due to the slots in the stator and rotor laminations is generally underestimated. The latter fact especially is of great importance.—*Zeitschrift des Vereines deutscher Ingenieure*, Feb. 5, 1921.

Mercury-Arc Rectifiers for Large Output.—M. GIROZ.—This article describes the present status of large-output mercury-arc rectifiers. All mechanical difficulties of building metallic containers holding a high vacuum are said to have been overcome. Rectifiers up to 900 amp. direct current or up to 2,000 volts direct current are in successful operation. At 1,500 volts direct current an efficiency of about 98.7 per cent has been reached, and it is of interest to note that the efficiency is the same, regardless of load. The alternating-current input power factor may be kept around 0.97, the voltage regulation at 3 per cent. In several Swiss and French substations the 600-volt trolley service is fed from such rectifiers with excellent results. As main advantages are claimed: (1) High efficiency, (2) quiet operation, (3) small floor space, (4) small amount of necessary attendance, (5) capability to stand overloads, and (6) no foundation required. —*Bulletin de la Société Française des Électriciens*, Vol. X, No. 93, page 375.

Generation, Transmission and Distribution

Distribution of Voltage Along Disk-Type Insulator Chains.—CH. DACHARY and P. GORCE.—A study was made to investigate the voltage distribution along chains of disk-type high-voltage insulators. Two types of disks were investigated—the Hewlett type and the disk with metal cap and cemented short rod. It is shown that a very high stress exists on the disk next to the line. With metal cap disks, when all disks are alike, the disk next to the line has to withstand up to 45 per cent of the line voltage. This figure may be reduced to about 17 per cent if double the capacity of the rest of the units is given to the last two disks, which may be done by enlarging the metal surface. For Hewlett-type disks a metallization is recommended, and for this the Schoop metal spray process proved very satisfactory. A great many curves of actual measurements of different chains under operating condition are given. —*Bulletin de la Société Française des Électriciens*, Vol. X, No. 93, page 345.

Removing Gases in Water by the Kestner System.—PERDRIZET.—Recognizing that the principal cause of deterioration of boilers is the gases in solution in the boiler-feed water and that the oxygen is by far the most detrimental of these, the author describes an apparatus by which the oxygen is removed from the water by chemical process.—*Revue Générale de l'Electricité*, Feb. 5, 1921.

Mechanical Construction of High-Voltage Transmission Lines.—H. KYSER.—The article deals in detail with the most suitable construction for supporting structures for high-voltage lines, taking up in turn wooden poles, fabricated-steel poles, reinforced-concrete poles, steel towers, towers for very long river crossings and their respective accessories and hardware. Simple, treated wood poles are recommended for all straight lines up to about 15,000 volts. Double poles and "A" poles should be used for angles, crossings and branch points. An interesting "lyra" steel arm for a three-wire line is described and illustrated which will hold and safely separate the lines even in case the top of the pole should break off. To avoid trouble from birds perching upon the cross-arms slanted steel arms are

recommended. For higher voltages and longer spans structural steel poles are more economical, and may be used up to about 60,000 volts. Above that rating towers will be cheaper, as they permit longer spans. As examples of river crossings nine spans, ranging from 223 m. to 739 m., are tabulated with all their details. The article is well illustrated.—*Siemens Zeitschrift*, February, 1921.

Traction

Arc Welding and Motor Maintenance.—A discussion of arc welding applied to electric railway equipment and a general consideration of motor repairs for this type of service.—*Electric Railway Journal*, March 19, 1921.

Electrification of Main-Line Railways in Relation to Traffic Working.—PHILIP NASH.—The writer asserts that one of the principal difficulties in forming a fair judgment of the advantages of electrification lies in obtaining true comparisons between steam and electric operation from actual results. He says that in many of the figures available the performance of new up-to-date electrical equipment is compared with steam locomotives designed many years ago. Nearly all electrification, he continues, can be shown to effect a direct saving in money over steam operation, though only in special cases will the direct savings be sufficient to pay interest and depreciation charges on the capital involved and leave any surplus profit. It is thus necessary to depend largely upon the collateral savings and benefits to justify the expenditure involved, and such collateral savings do not invariably accrue to a sufficiently important extent in main-line electrification.—London *Electrician*, March 4, 1921.

Installations, Systems and Appliances

Electric Arc Welding with Two Arcs in Series.—C. A. BOURGEOIS.—This article outlines a scheme by means of which it is feasible to connect two welding places in series, both being fed from one direct-current generator. Two contactor relays and two substitute resistances are necessary to permit the two welders to operate independently of each other. In case one of the arcs goes out the relays cut into the circuit the substitute resistance, which is short-circuited when both arcs are in play. It is obvious that the two welders must operate their respective arcs with the same current density. Not counting the cost of the generator, the author gives the cost of the complete equipment for two welding places as 2,000 francs.—*L'Electricien*, Feb. 1, 1921.

A New Gas Turbine.—Tests have been resumed at the works of Thyssen & Company with the gas turbine invented by H. Holzwarth, which was built in 1914. The vertical unit, it has been found, will be improved by horizontal construction. Four tests of a 500-hp. turbine of the horizontal type yielded the following results:

Test Number	1	2	3	4
Quantity of gas at 0 deg. C., 769 mm. mercury, meters per hour	300	400	550	660
Quantity of heat admitted, calories per hour	1,150,000	1,530,000	2,110,000	2,415,000
Useful horsepower	70	251	724	984
Heat consumption	16,430	6,090	2,915	2,450
Efficiency, per cent	3.9	10.4	21.8	26

—London *Engineer*, Feb. 11, 1921.

Use of Small Electrically Driven Rock-Drilling Machines.—THEO. HAUBER.—The article describes the successful use of a 1-hp. electric rock drill in a tunnel 1,280 m. long. The motor is of the squirrel-cage type, operating over a slip clutch a drill with 500 impulses per minute. Two of these drills were used at a time on one front, power being furnished from a 6-kva., three-phase generator driven by steam.—*Elektrotechnik und Maschinenbau*, Feb. 13, 1921.

Electric Trucks and Industrial Locomotives.—Attention is called to the usefulness of small electric trucks in manufacturing work of all kinds, and the article states that railway companies are utilizing these trucks to an increasing extent for carrying freight on station platforms. Small electric locomotives are employed frequently for the heavier class of service in steel works and similar industries, as well as for haulage work in connection with contracting jobs such as building and drainage. British experience with these devices is dealt with.—London *Engineer*, March 4, 1921.

Electric Melting in Non-Ferrous Industry.—EDWIN F. CONE.—Data showing the distribution of electric furnaces of each make according to location, number of furnaces, type of furnaces, capacity in kilowatts, and the character of product. The table gives the results

DATA ON ELECTRIC FURNACE DISTRIBUTION

Type of furnace	No. of Furnaces March 1, 1921	No. of Furnaces March 1, 1920
Ajax-Wyatt	178	118
Baily	82	61
Detroit rocking	57	44
Booth rotating	40	20
Rennerfelt	13	9
H. & H. electric reverberatory	1	..
Snyder	4	7
Von Schlegell	11	..
General Electric	8	..
Ajax-Northrup	11	..
Weeks	1	1
Ludlum	1	1
Greves-Etchells	1	..
Total	408	261

of this analysis, showing the increase in the number of furnaces in use March 1, 1921, compared with March 1, 1920.—*Iron Age*, March 24, 1921.

Electrophysics and Magnetism

Deleterious Effect of Fibers on the Electric Insulating Power of Oils.—THOMAS A. MCLAUGHLIN.—This article deals with research showing the very serious effect on the insulating value of transformer oil of the presence of fibers from cotton rags or waste used in cleaning containing vessels or otherwise introduced into the apparatus contained in the oil. The author finds the effects to be as serious as those previously reported by Japanese investigators.—London *Electrician*, March 18, 1921.

Structure of the Helium Atom.—IRVING LANGMUIR.—From a study of models for the helium atom the author concludes that Bohr's model is unsatisfactory because it gives too great a value for the ionizing potential and is not in accord with the optical and magnetic properties of helium. The chemical evidence suggests that each electron in an atom has its own separate orbit and that these orbits are closely inter-related. Accordingly two new models are considered: (1) In the double circle model the two electrons are assumed to move in two separate, parallel, circular orbits; (2) in the semicircular model each electron is assumed to oscillate back and forth along an approximately semicircular path in accord with classical mechanics, each being brought to rest at the end of its path by the repulsion of the other. The absolute dimensions of the

model were computed. The total energy comes out less than for the Bohr model, and the ionizing potential, 25.62 volts, agrees closely with the experimental value. —*Physical Review*, March, 1921.

Electrochemistry and Batteries

Copper-Nickel Alloys.—PAUL D. MERICA.—A study of the structure and properties of alloys used for driving bands, condenser tubes and coinage.—*Chemical and Metallurgical Engineering*, March 30, 1921.

Recent Work on Chromium-Tungsten-Steel Methods of Magnetic Analysis.—A description of the methods of magnetic analysis extensively utilized. The work of Japanese investigators is particularly considered. This is the first of a series of articles reviewing the literature on chromium-tungsten steels.—*Chemical and Metallurgical Engineering*, March 30, 1921.

Cost of Nitrogen Fixation in Norway.—T. C. HAGEMANN.—It is said that the object of the paper is not to make an accurate calculation of the cost of construction and working expenses of a plant for the manufacture of nitrates by the electrical oxidation of air, but, taking into consideration the market price of the products, to show that this process is profitable in Norway. For a medium-sized factory of, say, 40,000 kw. the output is estimated at 20,000 tons of HNO_3, the equivalent of 4,500 tons of nitrogen in the form of 29,000 tons Norwegian saltpeter with 13 per cent N and 4,400 tons sodium nitrate with 16.5 per cent N. The raw materials required will be 15,000 tons limestone, 500 tons lime and 2,500 tons soda. For the economical calculation the writer uses Norwegian kroner (1 kr. at normal exchange or parity equals $0.268, at present market $0.18). The market price of the nitrogen as required above is about 3,000 kr. per ton. Total selling price for 4,500 tons is 13,500,000 kr. Approximate running expenses, in kronen, are: Power, 40,000 kw., at 100 kr., 4,000,000; administration and wages, 1,500,000; raw and other materials, 1,100,000; packing, 1,000,000; sundries, 400,000; total, 8,000,000. Balance: 13,500,000 kr. — 8,000,000 kr. = 5,500,000 kr. The investment is estimated to be about 20,000,000 kr., and taking 7½ per cent, or 1,500,000 kr., for amortization, the profit will be about 4,000,000 kr. The cost of energy represents about one-half the total running expenses.—*Chemical and Metallurgical Engineering*, March 23, 1921.

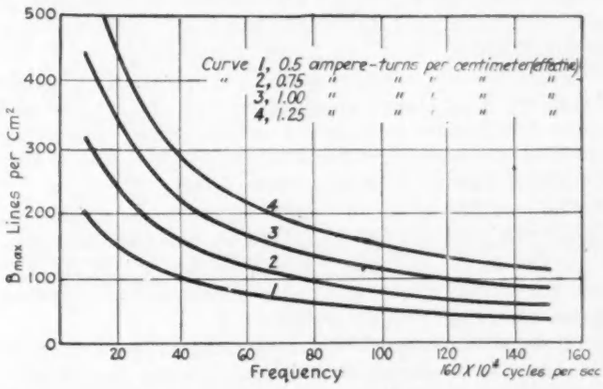
Units, Measurements and Instruments

Measuring Condenser Losses with Electrometer.—M. THIELERS.—In measuring power at a very low power factor—for instance, in determining condenser losses at high voltages—the electrometer may be advantageously employed as a wattmeter. For this purpose the condenser may be connected to the high-tension terminals of a transformer through a standard pure resistor. The midpoint of the transformer secondary is taken to the electrometer needle and the two pairs of quadrants are connected to the terminals of the standard resistance. But for certain terms of correction the deflection of the electrometer then is proportional to the condenser losses. The corrections may be made to vanish by introducing a balancing resistor symmetrically placed with respect to the standard resistor and by connecting the needle to the exact electrical midpoint of the transformer. If certain conditions are not fulfilled and if there is too high a capacity or too high losses in the electrometer considerable errors may enter into the results. After discussing the method, the author states that the electrostatic wattmeter has been successfully used for measurements of condenser losses up to 60,000 volts.—*Teknisk Tidskrift, Elektroteknik*, Vol. L, page 181.

Measuring of Power Factor by a Double Instrument. —W. FUHRMANN.—A kilowattmeter and an ammeter are combined in one instrument so that the pointers of the two cross each other. A number of curves have been drawn between the two scales, and the cross point of the two pointers indicates directly the power factor on the curve nearest to this point. A similar result may be obtained by combining two wattmeters. The instruments are being built by Hartmann and Braun.—*Elektrotechnische Zeitschrift*, Feb. 17, 1921.

Telegraphy, Telephony and Signals

Magnetic Behavior of Iron in Alternating Fields of Frequencies Between 100,000 and 1,500,000 Cycles.—LEON T. WILSON.—Mild steel ribbon, 0.002 in. (0.5 mm.) in thickness, was tested at various radio frequencies between 100,000 and 1,500,000 cycles per second for the relation between ampere-turns per centimeter and flux density and for core loss in watts per cubic



MAGNETIZATION CURVES FOR STEEL AT VERY HIGH FREQUENCY

centimeter at the various frequencies. A vacuum-tube oscillator supplied the necessary current for magnetizing the ring samples of steel. The method of measurement required the development of a precision radio-frequency voltmeter, which is described in detail. Some of the results are shown in the curves.—*Proceedings Institute of Radio Engineers*, February, 1921.

Development of Printing Telegraphy.—J. O. CARR.—The writer gives the historical development of printing telegraphy from the beginning, but confines himself to those systems which have had an influence on the development of systems in use in the United States.—*Journal Western Society of Engineers*, March, 1921.

Miscellaneous

Errors Involved in Solving for Constants of Fourier's Series by Calculation Method.—WARREN MASON.—The author considers (1) sources of error due to measurement of wave forms and due to higher harmonics, (2) error due to formulation of equations, and (3) error due to the assumption that no harmonics above the *m*th exist. —*Physical Review*, March, 1921.

Federal Power Commission Issues Rules and Regulations.—The first Federal Power Commission, just before relinquishing office, approved twenty rules and regulations to govern the granting of permits and licenses for the development of water power. These are given in full.—*Water Power*, March, 1921.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Contractors Blamed for Veto of Iowa Utility Court Bill

AFTER it had passed both houses of the State Legislature, the Governor of Iowa has vetoed the bill providing for a public utility court of appeal. The electric utilities of the state hold the electrical contractors primarily responsible and have threatened to withdraw their support from the contractor-dealer association. This bill, which had the approval of the utilities of the state, created what was called a "court of public service," but which to all intents and purposes was a state utility commission. At the office in New York of the National Association of Electrical Contractors and Dealers it was stated that no information had been received of any action taken by the Iowa State Association.

Under the bill utilities and cities were authorized to fix rates, but in case of disagreement the matter was to be laid before a court of public service consisting of three judges of the Iowa District Court, selected by the Chief Justice of the Supreme Court.

The court was to be empowered to determine on appeal the justness of rates fixed by municipal authorities, and in the event of failure of the city to fix just and reasonable rates was to be empowered to enter an order directing proper action.

In an action brought by a city the court was to be empowered to annul any indeterminate franchise—under which type of charter all utilities were to operate had the bill been signed—when public necessity should require. Either side could appeal from any order of the court to the Supreme Court of Iowa.

Power Commission Proposed for California

THERE is at present in the hands of the committee on government efficiency of the State Senate of California a bill creating a hydro-electric power commission and defining its powers. The proposed commission would not be much unlike the Hydro-Electric Power Commission of Ontario in its powers and would consist of three commissioners, two appointed by the governor and a third, who would be chairman, elected by the municipalities joining in the scheme.

According to the provisions of the act as amended in the California Senate the commission may acquire by purchase, lease or otherwise land, waters, water privileges, water powers, works, machinery, plant, transmission lines and appurtenances and all things necessary for the generation, transmission, storage and distribution of electricity. It may construct, maintain and operate works for that purpose and exercise the power of eminent domain in the name of the state.

The commission is empowered to apply for and obtain in the name of the State of California permits and licenses from the United States under the federal water power act and may enter into an agreement with the United States or with any other state respecting the use and conservation of interstate waters. It may also purchase electricity for distribution and resale.

The act provides for the supply of electricity to municipalities by contract and for the formation of rural syndicates which may also contract for service. The commission shall fix a monthly rate which may be changed at the end of six months, and provision is made for a readjustment of rates each year.

For the purposes of the act the commission is empowered to appoint a secretary and employ engineers, accountants, counsel and necessary assistants. It may also standardize accounting systems, methods, etc. It is felt by some power interests that the act has a chance of passage.

Northwest Superpower Survey Committee Organized

A STUDY of plans for guiding the economic power development of the Northwest, including the hydro-electric resources, is being undertaken by a Superpower Survey committee, which held its organization meeting in Portland, Ore., April 20. The committee plans not to confine its work to any one particular phase of the superpower project, but (a) to make a study and compile data to be available to the public, to capital, to existing and future operating companies, to industry in general and to commercial and legislative bodies, and (b) to further industrial development by an attempt to forecast and indicate such methods of power expansion, development and interconnection as will ultimately prove sound.

The conference had its inception in the Oregon Technical Council, where the need for such a study was keenly realized, and a representative committee has been appointed to undertake the work. Various subcommittees have been appointed to carry out its many phases, and these committees will report to the general committee, which will meet from time to time.

The personnel of the general committee is as follows: D. C. Henny, chairman, and J. C. Stevens, first vice-chairman, Spalding Building, Portland; Prof. C. E. Magnusson, second vice-chairman, University of Washington, Seattle; F. H. Murphy, secretary, Electric Building, Portland; R. M. Boykin, North Coast Power Company, Portland; R. Beeuwkes, Chicago, Milwaukee & St. Paul Railway, Seattle; W. H. Crawford, Portland Chamber of Commerce; E. R. Cunningham, Oregon Electric Railway Company, Portland; Prof. R. H. Dearborn, Oregon Agricultural College, Corvallis, Ore.; J. B. Fisken, Washington Water Power Company, Spokane; J. P. Growden, Skagit River Project, Seattle; F. F. Henshaw, United States Geological Survey, Portland; R. M. Jennings, Douglas County Light & Water Company, Roseburg, Ore.; E. W. Lazell, consulting engineer, Portland; L. T. Merwin, Northwestern Electric Company, Portland; C. P. Osborne, Portland Railway, Light &

Power Company; G. L. Parker, United States Geological Survey, Tacoma; W. M. Shepard, California-Oregon Power Company, San Francisco; G. E. Quinan, Puget Sound Power & Light Company, Seattle; H. H. Schoolfield, Pacific Power & Light Company, Portland; R. U. Steelquist, Mountain States Power Company, Albany, Ore.; W. R. Putnam, Idaho Power Company, Boise, and R. B. Childs, Intermountain Power Company, Seattle.

Georgia Electrical Interests Plan Co-operation

PLANS for a closer organization of and co-operation between the electrical interests of Georgia were discussed at the annual meeting of the Georgia Association of Electrical Contractors and Dealers, held in Atlanta April 22. A special meeting will be held in Macon on May 9 and 10, to which all branches of the electrical industry of the state are invited.

Addresses were made at the meeting by several of the jobbers relative to the need of more aggressive activity on the part of the electrical dealers and of employing experienced salesmen for the purpose of meeting the keen competition from the hardware, department and drug stores that is evidencing itself.

Ohio Public Utilities to Spend Half a Billion During 1921

INDICATIONS so far this year point to further investment of close to half a billion dollars being necessary for the utility companies of Ohio during 1921 to meet the growing demands for additional service made in almost every section of the state. To obtain part of this new capital many companies are encouraging customer ownership.

Ohio public utility companies during 1920 requested the State Public Utilities Commission to authorize them to sell $222,868,000 worth of new securities for the purpose of extending and improving their services to the people of the state, according to figures gathered by the Ohio Committee on Public Utility Information. Of this amount the commission sanctioned the sale of $218,441,134 of new securities.

Big Problems of Business Are Outlined by Commerce Chamber Head

THE ninth annual meeting of the United States Chamber of Commerce started on Wednesday at Atlantic City. President Joseph H. Defrees outlined the various important problems facing industry as a whole, the greatest of which, he stated, was the transportation problem.

Mr. Defrees took occasion to put on record the labor position of the chamber. The organization, he said, has no relation to the open-shop movement. It does, however, stand for the "principle of the open shop in its true integrity." Adequate attention must be given to foreign trade, the speaker said, before the employment problem, or for that matter the entire business situation, can be satisfactorily straightened out.

Other matters touched on were the tariff, which Mr. Defrees asked the chamber to consider in the light of the creditor position of the nation; federal taxation, "government in business," housing, education and immigration.

Larger Construction Program for Byllesby Properties

PLANS have been laid by the Standard Gas & Electric Company, the holding company for the H. M. Byllesby properties, to enter upon a somewhat larger construction program during 1921 than has prevailed in the last few years, all construction work in the recent past having been held down to a minimum. The growth of business in certain communities, the company says in its annual report for 1920, so urgently demands increased plant capacity that it is proposed to develop one hydro-electric station on the Pacific Coast and to enlarge the generating plants in certain other communities. Financial arrangements to cover the enlarged construction program are, it is stated, in the process of consummation.

Gross earnings of the company's subsidiaries amounted in 1920 to $32,352,232, an increase during the year of slightly more than five million dollars. Net earnings amounted to $11,230,741, which is an increase over 1919 of about a million and a quarter.

A. I. E. E. Annual Convention Program

DETAILS of the tentative program of the annual convention of the American Institute of Electrical Engineers, to be held at Salt Lake City, Utah, June 21, 22, 23 and 24, are announced this week as follows:

TUESDAY, JUNE 21

President's address, by Arthur W. Berresford; technical committee reports; "Hydro-Electric Developments at Niagara Falls," by J. L. Harper, Niagara Falls Power Company; "Modern Developments in Waterwheels," by W. M. White, Allis-Chalmers Company.

WEDNESDAY, JUNE 22

"Economic and Engineering Problems of the 220-Kv. Transmission," by L. E. Imlay, Superpower Survey, New York; "Voltage and Power-Factor Control of 66,000-Volt Transmission Lines Connecting Two Generating Stations," by Raymond Bailey, Philadelphia Electric Company; symposium on long-distance transmission systems, by F. G. Baum, consulting hydro-electric engineer, San Francisco; W. W. Lewis, General Electric Company, Schenectady, N. Y., and L. L. Elden, Edison Electric Illuminating Company of Boston; "Modern Production of Suspension Insulators," by E. H. Fritz, Pittsburgh High-Voltage Insulator Company, and G. I. Gilchrest, Westinghouse Electric & Manufacturing Company.

THURSDAY, JUNE 23

"Voltage and Current Harmonics Caused by Corona," by F. W. Peek, Jr., General Electric Company, Pittsfield, Mass.; "A Solution of the Porcelain Insulator Problem," by E. E. F. Creighton, General Electric Company, Schenectady, N. Y., and F. L. Hunt, Turner's Falls Power & Electric Company; "Transformers for Interconnecting High-Voltage Systems or for Feeding Synchronous Condensers from a Tertiary Winding," by J. F. Peters and M. E. Skinner, both of Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.; "Electric Strength of Air Under Continuous Potentials and as Influenced by Temperature," by J. B. Whitehead and F. W. Lee, both of Johns Hopkins University, Baltimore.

FRIDAY, JUNE 24

"Synchronous Motors for Ship Propulsion," by E. S. Henningsen, General Electric Company, Schenectady, N. Y.; "Magnetic Properties of Compressed Powdered Iron," by Buckner Speed and G. W. Elmen, both of Western Electric Company, New York; "Heat Losses in Conductors in Alternating-Current Machines," by W. V. Lyon, Massachusetts Institute of Technology.

Philadelphia Electric to Issue $5,000,000 More Preferred Stock

HOLDERS of common stock of the Philadelphia Electric Company will have an opportunity to subscribe to $5,000,000 of 8 per cent preferred stock at par. This is part of the $15,000,000 authorized last September, $6,000,000 of which has already been issued.

President McCall in his annual report for 1920, issued last week, said that there are now 12,731 holders of the company's common stock, 6,668 preferred stock holders and 12,738 bond and note holders.

The company's 1920 operating revenue amounted to $19,734,234.57, as compared with $16,014,256.65 in 1919. Expenses, however, were sufficient to absorb virtually all of this increase, for the 1920 operating income was $5,066,095.35, against $4,979,082.13 in 1919.

Municipal Ownership Inquiry at Boston

UPON motion of Councilor Watson, the Boston City Council voted Monday to authorize an investigation by its executive committee of the feasibility of the establishment by the city of a gas or an electric lighting plant. Very little popular interest in the matter is apparent at present, and the movement is chiefly sponsored by the sensational press. The Cambridge (Mass.) City Council has passed a vote favorable to the taking over by the city of the local electric lighting supply, but the vote has slight significance in view of similar action having been taken at odd times in the past apparently for its effect on the political fortune of the members of the Council. Under the Massachusetts law, to bring about municipal ownership a favorable vote must be had in two consecutive years and followed by a popular referendum, and unless all three steps are taken in order, municipal ownership cannot be instituted in a city or town already served by a utility.

Program for Contractor-Dealers' Convention July 18-23

FOR the twenty-first annual meeting of the National Association of Electrical Contractors and Dealers, to be held in Buffalo, N. Y., July 18 to 23, at the Lafayette Hotel, the following tentative program is announced:

Monday, July 18.—National executive committee meetings at 10 a.m. and 2 p.m., registration bureau opens at 4 p.m.

Tuesday, July 19.—National executive committee meeting at 10 a.m. and 2 p.m.

Wednesday, July 20.—Convention sessions at 10 a.m. and 2 p.m. in ballroom; opening address, E. D. McCarthy, Buffalo, chairman local convention committee; address of welcome, Mayor of Buffalo; response, James R. Strong, New York City, chairman National Association; historical address, Charles L. Eidlitz, New York City, first president of National Association; address, "The Business Outlook," speaker to be announced later; reception and dance at 8 p.m. in ballroom.

Thursday, July 21.—Convention sessions at 10 a.m. and 2 p.m.; "What a Trade Association Can Do and What Some Are Doing," by Charles S. Estey, Chicago; "Cost Data on Installation Work," by Kenneth A. McIntyre, Trenton; "Capitalizing Your Opportunities," by W. L. Goodwin, New York; annual dinner at 8 p.m.

Friday, July 22.—Convention session at 10 a.m.; "Financing for the Contractor-Dealer," by Alfred J. Martin, South Bend, Ind.; "The Conduct of a Contracting Business," by M. H. Johnson, Utica, N. Y.; trip to Niagara Falls in special trolley cars at 2 p.m.; trip over Gorge Route at Niagara Falls and visit to power house.

Saturday, July 23.—Meeting of national executive committee at 10 a.m.

Full details of the entertainment for ladies accompanying delegates are not completed. An automobile trip and a river trip have, however, been arranged.

New Interpretation Given to the Term "Navigable Streams"

A DECISION that has possibilities of affecting future development of water powers or streams not now thought of as navigable was made by the United States Supreme Court in the fight of the federal government to prevent the Economy Light & Power Company, now controlled by the Public Service Company of Northern Illinois, from constructing a dam across the Desplaines River near Joliet, Ill. The construction of the dam was undertaken and was resisted by the government. The Supreme Court in affirming the decisions of the lower courts based its finding largely on the fact that the stream in its natural condition had been navigated by early French explorers, fur traders and settlers in canoes and other light craft. That the stream has not been so used for a century was held as of no effect. The decision says in part: "We concur in the opinion of the Circuit Court of Appeals that a river having actual navigable capacity in its natural state and capable of carrying commerce among the states is within the power of Congress to preserve for purposes of future transportation, even though it be not at present used for such commerce and be incapable of such use according to present methods either by reason of changed conditions or because of artificial obstruction.

"We agree that the provisions of Section 9 of the act of 1899 apply to such a stream. The act in terms applies to any navigable river or other navigable water of the United States, and without doing violence to its manifest purpose we cannot limit its prohibition to such navigable waters as were at the time of its passage or are now actually open for use.

The Desplaines River after being of practical service as a highway of commerce for a century and a half fell into disuse partly through changes in its own condition, partly as a result of artificial obstructions. In consequence it has been out of use for one hundred years, but one hundred years is a brief space in the life of a nation; improvements in the methods of water transportation or increased cost in other methods of transportation may restore the usefulness of this stream.

New York Legislature Authorizes Fight on Federal Water-Power Control

BEFORE adjournment the New York State Legislature passed the following resolution, which is expected to bring before the courts for review the question of states' rights in connection with the federal water-power law:

Whereas the federal government has by the act of Aug. 8, 1917, assumed jurisdiction over the water powers of this state in common with other states and is now assuming to act in relation to the disposition of the same for national purposes to the exclusion of the state; and

Whereas such water power belongs to the State of New York and to its citizens, subject only to the right of the federal government to control navigation, and the federal government is not vested by the Constitution with any right or power to control over water power; and

Whereas such water power and the right of control over the same are of great value to the people of the state for public use for heat and power as a course of commercial

development and revenue to the state, of which they will be deprived under said law by the action of the federal government;

Now therefore be it resolved, That the Attorney-General of this state be and he hereby is authorized to take such action as he may be advised in the premises for the effectual protection of the interests of this state and that he is further authorized to co-operate with the duly constituted authorities of other states to the same end.

New York State Water-Power Measure Passed by Legislature

NEW YORK'S water-power measure, providing for the development of the state's water-power resources, was passed by the Legislature and is now before Governor Miller for his signature. That the bill will become a law seems certain as it had the Governor's approval and support when introduced.

This bill provides, as stated in the ELECTRICAL WORLD of March 26, page 728, for a commission of five to have charge of the leasing of the state's water power along the lines of the federal water-power bill. Licenses will be granted by the commission to permit of the diversion and use for power or other purposes of the waters of the state in which the state has a proprietary right or of boundary waters over which the state has jurisdiction. The commission will have power to issue a license for a period of fifty years and is to accord preference to the applicant whose plans are best adapted properly to develop, conserve and utilize the water power of the watershed, stream or locality.

Line Extension Rules for Northwest Being Formulated

THE governing committees of the commercial and technical sections of the Northwest Electric Light & Power Association held a joint meeting in Portland, Ore., on April 22 for the purpose of formulating a set of standard rules and regulations to govern line extensions to be adopted by the electrical utilities in the Northwest. It is not expected that the committee will make a report of its findings before the convention of the association, which will be held in Portland in June.

Kansas City Electrical Show Successful

WITH a total of nearly 75,000 admissions, Kansas City closed its electrical show on Saturday night last. There were 115 exhibitors. The exhibits covered not only household and similar appliances, but power equipment for industrial uses, transmission and distribution line equipment and virtually every device except heavy electrical equipment and that for power-house purposes.

A notable feature was the exhibit from the trade and domestic science departments of the public schools. In the trade section electrically driven woodworking, printing and wireless-telegraph equipment installed by the students was in constant operation. The domestic science department had ranges, refrigeration and other kitchen equipment and a complete sewing room in operation.

The general illumination of the convention hall area was a feature that attracted a great deal of comment. This lighting, for which Manager Furst was responsible, was laid out for 15 foot-candles on the lighting plane and 16 foot-candles was actually secured. Eighty 1,000-watt "tip-up burning" lamps were used in inverted-bowl reflectors to provide the illumination, which was indirect.

The Kansas City Power & Light Company had a booth that attracted a great deal of attention and presented a display valuable from an educational standpoint. A number of novel electrical "stunts" helped to entertain the spectators. These were placed against a background of all sorts of electrical equipment, including meters, line materials, a section of 33-kv. line construction and a large oil circuit breaker, equipped for operation and used for demonstration purposes. Household and industrial appliances were avoided, and the exhibit was confined to equipment used in rendering service.

One feature of the show was the absence of the commercial concessions ordinarily seen. Even the giving away of advertising novelties or anything of a like nature was forbidden. The show was conducted in co-operation by the electrical interests of Kansas City. The management gave its services voluntarily.

Italian Commission Here to Study Railway and Industrial Electrification

THE Italian Commission on American Railway and Industrial Electrification arrived on the steamship Lorraine Monday, April 25. The commission consists of Guido Semenza, consulting engineer and past-president of the Associazione Elettrotecnica Italiana and

THE ITALIAN MISSION JUST BEFORE DISEMBARKING, READING LEFT TO RIGHT, PROF. G. G. PONTI, G. SEMENZA, MRS. PONTI AND COL. C. SCARELLI

honorary secretary of the American Institute of Electrical Engineers, as chairman; G. G. Ponti, professor at Turin University and general manager of the Società Idroelettrica Piemonte ed Elettricita Alta Italia, and Col. Cesare Scarelli, delegate from the Italian War Office. Two other members are expected, Marquis F. Cusani, delegate from Italian industries, and a delegate from electric traction services, Italian State Railways.

Italy is planning to electrify about 5,000 miles of her railways, and the commission has been sent to America to study the systems of railway electrification here. It is the intention of the commission to visit the more important developments in this country, including power generation and transmission, railway electrification and application of electricity to industries. The commission will remain in the United States for about two and a half months and will cover the principal towns of the Eastern, Central and Western States.

Pennsylvania Power & Light to Add 20,000-Kw. Unit

ADDITIONAL generating capacity will be added by the Pennsylvania Power & Light Company by the installation of a new 20,000-kw. unit at its Hauto plant. Plans are also under consideration for increasing the capacity of this company's Harwood plant by replacing a 4,000-kw. unit with one rated at 12,500 kw. Work on the new unit at the Hauto plant will be started at once and if possible completed within the present year. This installation, together with that of 12,500 kw. at the Harwood plant, if made, will give the Pennsylvania Power & Light Company a total generating capacity of 112,150 kw.

For the past few years this company has been unable to keep pace with the demand for power in its territory. The additional capacity is expected to meet only the requests for power which the company has formerly been compelled to refuse and does not provide any surplus of unsold capacity.

Missouri Convention Discusses Valuation

PRESENT-DAY value as a basis for rate making was the subject of considerable difference of opinion before the Missouri Association of Public Utilities at Kansas City on Thursday of last week. R. A. Brown, attorney for the St. Joseph Railway, Light, Heat & Power Company, presented a review of court decisions and an argument for the present-day cost basis. The difference of opinion was less in evidence in the formal discussion than in the comment exchanged informally among those in attendance after the session in which the paper was presented. This informal discussion brought out a very strong feeling that before the problem could be solved some other basis of valuation and return that would recognize other factors essential to the success of the utility business must be recognized.

The rural-service problem came in for the usual share of attention when N. T. Wilcox of Keokuk, Iowa, presented a strong statement of the cost of service, showing that in some cases this cost could run as high as $50 per month. This possibility exists in a territory where the farms average about 160 acres and small communities are not included in the service. The importance of putting the business on a basis where good service could be rendered and the necessity of substantial line construction were strongly stressed by Mr. Wilcox. Mr. Wilcox asserted that the mistake made by the average company is lack of appreciation that the service has a definite value as one that must be sold on a service and not a kilowatt-hour basis.

H. H. Kahn of Kansas City discussed the "Concentration of Generating Equipment at Centers of Economical Production and Transmission," pointing out the possibility of a superpower district including Missouri, Kansas and Arkansas.

Dean McCaustland of the School of Engineering, University of Missouri, discussed the relation of engineering education to industry, citing engineering education as the foundation stone of American industry.

President Martin J. Insull of the National Electric Light Association addressed the joint meeting of the Kansas and Missouri associations on Thursday, outlining the work of his association and urging the necessity of creating better public relations.

The officers for the coming year are: President, H. Spoehrer, St. Louis; first vice-president, E. R. Locke, Mexico; second vice-president, E. C. Deal, Springfield; third vice-president, H. C. Blackwell, Kansas City; secretary and treasurer, F. D. Beardslee, St. Louis; executive committee, L. P. Andrews of Sedalia, J. D. Von Maur of St. Louis and L. B. Landman of Jefferson City.

Those in attendance were taken through the 75,000-kva. Northeast powerhouse of the Kansas City Power & Light Company on Saturday.

"Build Business for the Long Run," Says L. H. Parker

THAT the present is a time to lay firm foundations for future business both in this country and abroad is the opinion of L. H. Parker, president Spray Engineering Company, Boston, who has recently returned from an eleven weeks' trip to the British Isles, France, Italy, Switzerland, Belgium and Holland. The object of Mr. Parker's trip was to investigate the overseas situation as regards the marketing of his company's products. Six weeks were spent in London and Paris.

LEE H. PARKER

To a representative of the ELECTRICAL WORLD Mr. Parker declared that the deflation process resulting from the war appears to be making steady progress throughout both Europe and America, and that as this is gradually accomplished business conditions must improve. The resumption of better business in Europe hinges largely upon Germany's paying the reparations demanded.

The building of trade for the long run instead of for immediate quick profits is receiving much attention on the other side, and Mr. Parker said that the pursuance of the former policy to a greater extent in this country would be most wise. Contrary to press reports, Mr. Parker found popular sentiment very friendly to America in the countries visited, and a better understanding of America's international position and aims appears to be gaining ground. At all times, he feels, it is a good plan to undertake preliminary work looking toward the development of export trade from the United States. Considerable interest in steam railroad electrification is being manifested in Italy, France and Holland, and large purchases of electrical and allied apparatus seem destined to be made.

The outlook for this country, Mr. Parker stated, is optimistic. Deflation has made good progress since he left for Europe late in December, and a better feeling in trade is now apparent. The people in the foreign countries visited are tired of fighting and revolutionary agitation, and ex-service men overseas as well as here are exerting a stabilizing influence. Disturbing as is the exchange situation, it is gradually yielding to the

deflation process. The great natural resources of the United States, the readiness of its factories for mass production, our ample supply of man power, the high intelligence of our population and our far greater use of modern methods augur well for the future development of the country, gradual though the resumption of normal conditions must be because of the immense burdens imposed by the war.

Theoretical Engineer Has Important Function, New York Men Hold

THAT there is an important place in the profession for the "theoretical" or research type of engineer appeared to be the consensus of opinion brought out at a joint meeting of the New York Section, A. I. E. E., and the Metropolitan Section, A. S. M. E., held on April 22. Regarding the training of these men who are chiefly responsible for the revolutionary developments in the science of engineering, however, there appeared to be considerable difference of opinion.

Prof. Comfort A. Adams, chairman Engineering Division, National Research Council, presided, and in introducing the speakers indicated the two general schemes of engineering education in which (1) the fundamentals are emphasized and (2) a large number of facts are given. Teaching of fundamentals he considered right and the other method superficial. Prof. Walter Rautenstrauch of Columbia University believed that progress would be relatively slow were it not for the engineer of high theoretical attainments. In engineering teaching he believed that quality should be emphasized and that students should be encouraged to express themselves in clear English rather than by formula.

Dean Frederic L. Bishop, University of Pittsburgh, said that no university in the country is adequately equipped to train the theoretical engineer, although several of them are developing research work to an encouraging extent. He quoted data that have recently been gathered showing that high scholastic standing is of greater importance to the engineering student than has commonly been acknowledged. Records show that most eminent engineers of today stood high in scholarship as undergraduates. C. R. Dooley, manager personnel and training Standard Oil Company of New Jersey, believed that the best results can be obtained by encouraging whatever talents engineering students possess.

It was announced at this meeting that Farley Osgood, vice-president and general manager Public Service Electric Company of New Jersey, had been elected section chairman and Harlan A. Pratt secretary.

President of Houston Company Proposes Guaranty Fund and Lower Rates

THE president of the Houston (Tex.) Lighting & Power Company, Edwin B Parker, has publicly declared in favor of a plan by which the surplus profits now divided between the city and the company will be devoted to the creation of a guaranty fund, to be followed by the reduction of rates as far as practicable to yield an 8 per cent return on the company's investment, any deficiency to be made up from the fund. Mr. Parker said that since 1914 the company had paid out nearly $2,000,000 in cash in additions and betterments to keep pace with Houston's growth. This, he said, had been made possible by passing the dividends of the company and devoting these sums, together with the company's share of the surplus earnings, to such betterments and additions, while continuing to pay the city its share of profits under the agreement.

Business Conditions Getting Better

BUSINESS conditions throughout the country are getting better. This is indicated by a distinct gain for March over February in the volume of distribution by jobbers and retailers, according to Archer Wall Douglas, chairman of the committee on statistics and standards of the Chamber of Commerce of the United States. The whole tone of Mr. Douglas' report is optimistic. He points out many signs as indicative of an improvement in the situation and as tending to foreshadow a return to more settled and stable conditions. Among these signs are a resumption of operations in a modest way by some automobile factories which were shut down but which now have orders in hand, a better demand for lumber and prepared roofing and paint because of somewhat more building and construction, the unusually fine crop conditions of winter wheat, and the fact that the farmer, while economizing on some things, is also buying somewhat more freely, especially in the grain region, which Mr. Douglas holds to be a healthy sign, for the genuine beginning of better times is likely to come in agricultural rather than industrial life.

Department Heads Send First Messages from New Post Office Radio Station

THE big new radio station in the Post Office Department to be used in connection with the air-mail service was formally opened April 22 in the presence of Postmaster-General Hays, Secretary of Agriculture Wallace and officials of the Post Office and Agricultural Departments. These two departments will co-operate in the distribution of a national radio marketgram service by the use of the various air-mail radio stations. The air-mail service has major raido stations at Washington, D. C.; Bellefonte, Pa.; St. Louis, Mo., and Omaha, Neb. With these stations and the fifteen minor radio stations operated by the service, together with more than 6,000 licensed amateur operators almost every farmer will be able to receive each day market reports.

Those in the picture, reading left to right, are J. C. Edgerton, chief of the air-mail radio service; Secretary of Agriculture Wallace, Postmaster-General Hays, Charles F. Marvin, chief of the Weather Bureau; Dr. S W Stratton, Bureau of Standards, and W. A. Wheeler, director of markets.

Revised Edition of "Electrical Salesman's Handbook" Soon Ready

INSTEAD of being issued at one time as a complete loose-leaf book, the N. E. L. A. "Electrical Salesman's Handbook" is being thoroughly revised and each section will be published in a separate flexible card cover. Two of these sections, one on "Industrial Lighting" and the other on "Lamp Equipment for Commercial and Industrial Lighting," are now on the press and can be ordered.

The revised handbooks are to be sold instead of given away. However, the prices, it is stated, will only cover the cost of printing and distributing. The price of the sections now being printed is 50 cents a copy.

Electrochemical Society Forms Division on Electrothermics

AT THE thirty-ninth general meeting of the American Electrochemical Society held in Atlantic City April 21 to 23 there were three technical sessions, one on "Arc Welding and Electric Furnaces," another on "Electrolytic Products and Cells," and a third on "Corrosion."

O. H. Escholz presented a detailed account of a study of the "Phenomena of Arc Welding," which was illustrated by lantern slides. In the discussion of this paper the importance of protecting the operator was emphasized and the use of automatic welders wherever possible in order to eliminate the personal factor was recommended.

In a paper, "Electric Furnaces for Non-Ferrous Metals," H. W. Gillett of the United States Bureau of Mines gave a detailed summary of all the electric furnaces in operation in the United States melting nonferrous metals. It was brought out that electrometallurgy has made great strides in the last five years and the electric furnace has been firmly established in th brass and bronze industries.

Dr. Carl Hering in a paper, the "Electro-Dynamic Forces in Electric Furnaces," described the various "effects" met with in the operation of electric furnaces.

Dr. E. F. Northrup presented a paper on "Recent Progress in High Frequency Inductive Heating," pointing out that so far only star connection was found practicable as the delta connection does not work properly. In this type of furnace he stated that he has melted fairly large quantities of very high melting alloy composed of tungsten, osmium and a little nickel.

"Regulation of Electric Steel Arc Furnaces Using Movable Electrodes" was the topic of a paper by W. G. Mylius. B. S. Cushman presented a paper by T. W. Case on the "Photo-Electric Effect in Audion Bulbs of the Oxide Coated Filament Type."

At the business session on Thursday of the society the board of directors sanctioned the formation of a division on electrothermics which will include all those members interested in electric furnaces, electric steel, electric brass refractories, electrodes, regulators, heat treating apparatus, etc. Acheson Smith is chairman of the new division. Regarding the formation of a division on electrodeposition a committee of three, consisting of William Blum, George B. Hogaboom and H. S. Lukens, was appointed to ascertain whether such a division would meet with the necessary support and encouragement.

At the annual business meeting on Friday the following officers were elected: President, Acheson Smith; vice-presidents, Charles L. Burgess, C. G. Schluederberg and E. L. Crosby; managers, Carl Hering, J. V. N. Dorr, F. A. J. Fitzgerald, and secretary, Joseph W. Richards.

The place of meeting in the fall was definitely fixed as Lake Placid, N. Y., Sept. 28 to Oct. 1, at which time a session on Non-Ferrous Electro-Metallurgy and a session on Electrodeposition will be held. At the spring meeting, 1922, a session will be devoted to Electric Furnace Cast Iron.

Arkansas Utility Men Arrange Program

PLANS have been completed for the holding of the convention of the Arkansas Utilities Association at Hot Springs, Ark., May 11 and 12. The program as tentatively arranged is as follows:

WEDNESDAY, MAY 11

Morning Session.—Registration; address of welcome, Mayor, Hot Springs National Park; response, H. C. Couch, president Arkansas Light & Power Company, Pine Bluff; address of president, C. J. Griffith, Little Rock; report of secretary and treasurer, W. J. Tharp, Little Rock; report of executive committee, C. J. Griffith, Little Rock; report of committee on taxation.

Afternoon Session.—Paper by representative of telephone company; "Efficient Fuel Combustion," by W. G. Shurgar, combustion engineer Little Rock Railway & Electric Company.

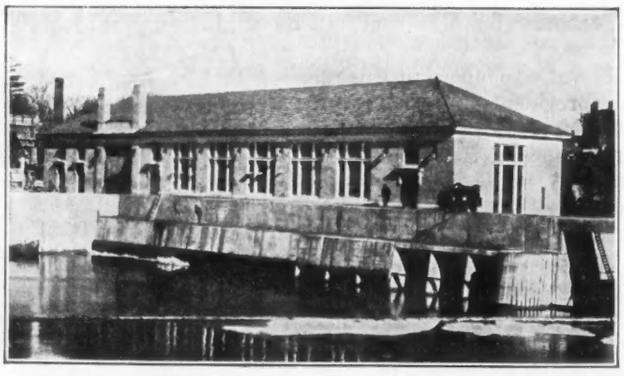
THURSDAY, MAY 12

Morning Session.—"The Value of Pure Water," by M. J. Blair, chief sanitary engineer State Board of Health, Little Rock; "Publicity," by A. G. Whidden, advertising manager Arkansas Light & Power Company, Pine Bluff; "Inductive Interference," by W. J. Canada, engineer National Electric Light Association.

Afternoon Session.—Joint meeting class A and class B members; "Merchandising," paper by a class B member.

The convention will be immediately followed by that of the Southwestern Geographic Division of the N. E. L. A., to be held May 13 and 14 at Hot Springs.

Central Maine Power Completes New Hydro Plant



IN THIRTEEN months from the time it was started the Skowhegan hydro-electric plant of the Central Maine Power Company was completed. The plant operates under a 32-ft. head and has an initial installation of three 4,250-hp. units.

There is room in the plant for another similar unit, and provision is made for extending the plant in case a fifth unit is desired

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Hydro-Electric Development in North Carolina.—Eight hydro-electric plants, developing a total of more than 3,000 hp., have been placed in operation or will be running inside of ninety days in the neighborhood of Hickory, N. C., according to the president of the construction company, as quoted in the *Manufacturers' Record*. Two plants are now being completed in Alexander County, and in Little River, 10 miles from Hickory, one of the largest of the light plants is nearly finished. Lower down on the same river the North State Cotton Mills Company is building a 200-hp. plant. Other developments in the near future are contemplated in Burke and Catawba Counties.

Idaho Power Company Rates.—Valuation proceedings in order to fix rates for the Idaho Power Company have opened before the Idaho Public Utilities Commission at Boise. The report presented by the company's valuation engineer fills thirty-seven large volumes, and an indefinite continuation of the case was taken to give the commission time to examine it. A recent order of the commission authorized the power company to pay to the city in yearly installments the sum of $35,594.73, being the amount of the franchise tax due on account of the Beaver Dam Light & Power Company. The order also allowed the company to file a schedule of rates with the commission to reimburse it for this tax. The city has agreed to an extension of the time within which the company must comply with this order, but it objects to the filing of new rates.

The Radio Megaphone.—Interesting facts concerning the radio megaphone developed and arranged by Prof. Alfred N. Goldsmith of the College of the City of New York are printed in the *Wireless Age*, which says this instrument is the result of fourteen years of diligent research in the college's department of electrical engineering, no claim to invention of the apparatus being made by Professor Goldsmith. The new amplifier, the *Wireless Age* says, is distinguished from others by its extreme sensitiveness, its reliability, the high power of its amplification, the evenness and clearness of its tones and its ability to receive from long distances. With it messages passing between Nauen, Germany, and New Brunswick, N. J., Stavanger, Norway, and Marion, Mass., Lyons, France, and Tuckerton, N. J., Carnarvon, Wales, and New Brunswick, N. J., are heard at the college station with great distinctness. A commercial advantage of the apparatus is that by its use the cumbersome head harness worn by wireless operators becomes unnecessary.

"Hydro Municipalities" in Ontario.—In this department on April 16 a list of the "hydro municipalities" of the Province of Ontario was given with what purported to be the horsepower output of each. The engineering department of the Hydro-Electric Power Commission of Ontario calls attention to the fact that the figures as printed were erroneous, they being population figures and having no relation to either domestic consumers or power supplied.

Prospects of Railroad Electrification in England.—It is reported on what the *Electrical Times* of London says looks like good authority that the North Eastern Railway of England is about to start a long-projected electrification of its main line between Newcastle and Darlington, a distance of about 35 miles. Uncertainty of the action that may be taken by Parliament holds back virtually all schemes for railroad electrification in Great Britain, but the North Eastern line is said to be in a particularly favorable condition as regards absence of competition and relatively dense traffic, nor is it threatened with serious interference by "grouping" proposals.

Electric Iron Smelting in Sweden Gets Setback.—A serious blow has, according to London *Engineering*, been dealt to the electric iron smelting industry in Sweden by the stoppage of the Porjus iron works. They were started in 1916 and from a technical point of view had been entirely successful, the cost of production being reduced. The expenditure for plant extensions, however, far exceeded the estimates and the capital proved insufficient, while prices of the product fell and demand dwindled. Last year's output of pig iron was only 12,500 tons, despite a large foreign market. A department for alloys which had been in operation only a short period had employed a staff of expert engineers.

The Queenston Hydro-Electric Plant.—It has now been officially announced that the Queenston-Chippawa development of the Ontario Hydro-Electric Power Commission will undoubtedly be ready to deliver power by next September. This power will probably be sold upon a basis of approximately $10 per horsepower at the generating station. The government's estimate that the total cost of the development will be about $55,000,000 is figured on the basis of 500,000 hp., or $110 per horsepower. It will be necessary for Canada to obtain permission to divert more water from Niagara Falls in order to operate the Queenston plant to full capacity if the other plants on the Canadian side of the Niagara River are also to be operated, and to this end negotiations will have to be opened with the United States. Estimates for capital expenditures by the Ontario Hydro-Electric Power Commission for the current year total $36,937,000, of which $26,700,000 is for the Queenston-Chippawa plant.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

New Orleans Electrical Men Organize.—A hundred representatives of the electrical industry in New Orleans met recently and organized an association for the advancement of electrical interests in that city. Leo Hirsch, president and general manager of the Electrical Supply Company, was chosen president; T. V. Sharp was made vice-president, and F. H. Ames, secretary and treasurer of the Gulf States Electrical Company, was elected secretary-treasurer.

O. E. L A. Holds Meter Conference.—A meter conference under the auspices of the Ohio Electric Light Association was held at Cincinnati on April 22 and 23. Problems in power-factor measurement were discussed by B. F. Cleaves of Altoona, Pa.; J. C. Langdell of Jackson, Mich., and Mr. Currier of Philadelphia. Meter department activities were dealt with by C. M. Goldberg of Cincinnati. A. S. Yard and J. R. West told of interconnection metering on the Windsor system, D. J. Angus discussed the design of graphic instruments, and William Hubbell presented a paper on meter-board construction.

Coming Meetings of Electrical and Other Technical Societies

A. I. E. E. Section Meeting—Vancouver, B. C., May 6.
A. I. and S. E. E. Section Meetings—Philadelphia, May 7; Cleveland, May 9.
American Association of Engineers—Buffalo, May 9-11.
Society for Electrical Development Annual Meeting—New York, May 10.
N. E. L. A., Southwestern Geographic Division—Hot Springs, Ark., May 13-14.
American Washing Machine Manufacturers' Association—Chicago, May 18-19.
Southwestern Electrical and Gas Association—Galveston, Tex., May 18-21.
National Electric Credit Association—Richmond, Va., May 19-20.
A. I. E. E. Annual Meeting—New York, May 20.
American Society of Mechanical Engineers—Chicago, May 23-26.
Electrical Supply Jobbers' Association—Hot Springs, Va., May 25-27.
N. E. L. A. Annual Convention—Chicago, May 31-June 3.
N. E. L. A., Pacific Coast Division—Del Monte, Cal., June 7-9. (For program see issue of Jan. 29, page 278.)
N. E. L. A., North Central Division—Duluth, Minn., June 14-16.
National Fire Protection Association—San Francisco, June 14-16.
Tri-State Water and Light Association—Asheville, N. C., June 15-16.
Canadian Electrical Association—Quebec, June 15-17.
California State Association of Electrical Contractors and Dealers—Santa Cruz, June 16-18.
A. I. E. E. Annual Convention—Salt Lake City, June 20-25.
National District Heating Association—Cedar Point, Ohio, June 22-24.
Association of Municipal Electrical Utilities of Ontario—Toronto, June 28.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Reproduction Cost New Not Now a Reasonable Basis for Rates.—Fixing the rate base of the Southern California Edison Company at $94,075,000, the California Railroad Commission said: "Without question, to construct the plants now in existence under conditions of labor and material costs during the past year would result in a much greater figure than the investment. The commission, however, does not hesitate to state that reproduction cost new or reproduction cost depreciated based upon price conditions existing during 1919, 1920 and 1921 is not a reasonable basis for rate-fixing purposes except in so far as it applies to those portions of the properties that were of necessity constructed during the period of high prices."

Montana Commission Holds that Tide Has Turned.—A recent pronouncement from the Montana Public Service Commission declaring that while the policy of granting rate increases had already justified itself by preserving intact for better times services which must have been exhausted without this relief went on to say: "There is a most definite turn in the tide of financial affairs today, however, a turn consequent on the general effort at reconstruction, and we should fail in our duty if we did not recognize it now. The solution of fundamental problems can no longer be deferred, nor the demands of patient but weary consumers further ignored. Reconstruction has as definite an application to public utility affairs as it has to any other incidents of commercial or industrial life."

Every Division of a Joint Public Service Company Must Stand on Its Own Feet.—The principle that the owners of a utility furnishing more than one kind of service must not make up a deficiency in one branch by revenues derived from another received further indorsement when, in applying it to the Elmira Water, Light & Railway Company, the New York Public Service Commission for the Second District said: "The city very well argues that if the rule contended for by the company were in force a paying utility in any community might acquire another utility of a different nature which was non-remunerative and on account only of a combination of ownership become entitled to place upon the customers of the prosperous utility the burden of paying the cost of operation and also yielding a profit upon the unsuccessful utility, in which they might have little or no interest."

Emergency Relief Not Always Justified.—According to views expressed by the Public Utilities Commission of Connecticut in hearing a complaint made by the city of Meriden against the Meriden Gas Light Company, a public utility company which has declared extra dividends and has paid a large return on the value of the property during prosperous years and has set aside a substantial depreciation reserve fund and accumulated a large surplus account will not be allowed emergency relief in that state until after it has drawn upon such surplus to meet deficiencies in current operating revenue. The commission refused to accept the theory that surplus accumulated from operating revenues has no bearing on the question of rates and that patrons have no interest in the surplus or in surplus earnings.

Return to Normal Water Conditions Brings Reduction in Agricultural Rates.—The California Railroad Commission has made a temporary order, pending valuation proceedings, which will, it is estimated, result in an average reduction of approximately 5 per cent in the San Joaquin Light & Power Corporation's revenue from agricultural service, based on what the commission holds to be a return to virtually normal water conditions on the company's system. The new schedule is a combination of an energy and a demand-and-energy rate, and by it consumers who use energy for short periods only will pay increased rates, while those operating continuously from eight to twelve months will pay rates materially less than they have been doing. The commission disagreed with the contention that a reduction in earnings would prevent the flotation of additional bonds and thus put a stop to the company's construction work.

Relation Between Rates and the Ability to Command New Capital.—In its decision on the rates to be allowed the Southern California Edison Company (see issue for April 16, page 898) the California Railroad Commission said: "The commission fully appreciates the interrelation between the earnings of a utility and its ability to command new capital from investors to provide the facilities required by the growing demands of its business and its obligation to the public. This does not mean, however, that the commission will permit applicant or any other utility to charge in excess of a reasonable rate in order that additional capital can be secured. No measure of earnings can be approved by a body such as this commission, charged with the protection of the public interest, which does not result, for equal benefits, in a rate as low as or lower than the rate which would be fixed upon the standard accepted basis of a fair return upon the reasonable value of the utility properties. In this, therefore, as in other rate-fixing proceedings, the primary consideration is a fair return upon the properties used and useful in the public service."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Only Condition Under Which Commission's Findings of Fact May Be Set Aside.—Findings of fact by the Public Service Commission, declared the New York Supreme Court, Appellate Division in People ex rel. New York Central Railroad Company vs. New York Public Service Commission, Second District, cannot be disturbed by the court in proceedings to review an order of the commission unless the finding is such as in a case tried or triable by a jury would be set aside by a court as against the weight of evidence. (187 N. Y. S. 24.)*

District of Columbia Consumers Cannot Claim Equal Treatment with Government.—A bill in equity filed in the United States Supreme Court (Hollis vs. Kutz) sought to have an increase in gas rates to consumers in the District of Columbia declared void, the main contention being that in raising rates the Public Utilities Commission had not applied the increase to the United States government and the District administration. This contention was declared without merit by the court, the government having the power to fix the price for its own needs as a condition to allowing the establishment of the business in the District of Columbia. (41 S. C. R. 371.)

City May Proceed Under Public Utilities Law Instead of Under Franchise Provisions in Acquiring Plant.—The city of Superior, Wis., having determined to take over the waterworks of the Superior Water, Light & Power Company pursuant to franchise provisions, the company named brought suit against the city for not proceeding in the manner specified in the contract instead of under the provisions of the public utility law in arriving at a just compensation. The Wisconsin Supreme Court has refused to entertain the plea, holding that the method followed by the city is proper, all property being held subject to the right of the state to acquire it for public purposes whenever it may see fit to do so; that the law under which the city is proceeding assures the water company adequate compensation, and that it is to be assumed that that is all a valuation according to the provisions of the contract would give it. If the contrary were assumed, the question would arise whether a court of equity should decree the specific performance of the agreement. (181 N. W. 113.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

E. P. Edwards, who has been assistant manager of the lighting department of the General Electric Company for a number of years, has been made responsible for the radio activities of the company. His duties will include immediate supervision of radio engineering, manufacturing and selling, negotiations with the Radio Corporation of America and other companies and general directing of the efforts of the company in the field of radio communication. Mr. Edwards has been connected with the General Electric Company since 1899. He was born in Louisville, Ky., and after graduation from the Rose Polytechnic Institute, Terre Haute, Ind., in 1899, was first employed in the electrical department of the Ohio Steel Company, Youngstown, Ohio, from which he resigned to become connected with the General Electric Company. After completing the test course he entered the meter, instrument and switchboard department and later the lighting department. Mr. Edwards first became interested in radio communication through association with Prof. R. A. Fessenden in connection with the latter's early activities with the National Electric Signaling Company. It was during this period that the General Electric Company designed and manufactured the first Alexanderson high-frequency alternator, which was used by Prof. Fessenden in his experimental station at Brant Rock, Mass.

E. P. EDWARDS

J. I. Banash, formerly of the Underwriters' Laboratories, Chicago, has opened a consulting engineering office at 3642 Jasper Place, Chicago.

Thomas H. S. Andrews, heretoforе connected with the engineering staff of the J. G. White Engineering Corporation, New York City, has become affiliated with the E. G. Long Company of the same city as secretary.

S. Jacobs, for the last six years a member of the staff of the California Railroad Commission, acting in that time as assistant chief engineer of the gas and electric division, resigned recently. Mr. Jacobs will enter private practice, specializing as a consulting engineer in the gas and electric field. During his connection with the commission he took part in many important cases.

E. W. Lewis has resigned as assistant general manager of the Iowa Railway & Light Company and has entered the business field for himself, forming the firm of E. W. Lewis & Company, wholesalers of electrical supplies. Mr. Lewis first entered the electrical industry with the Onondaga Dynamo Company at Syracuse, N. Y. After seven years with that company he resigned to take the apprentice course with the Westinghouse Electric & Manufacturing Company at East Pittsburgh, Pa. He was later transferred to the Baltimore office of that company. In 1908 he took charge of the electrical department of C. E. Fawcett, manufacturer of mill supplies at Cedar Rapids, Iowa.

E. W. LEWIS

Three years later he became connected with the Iowa Railway & Light Company as superintendent of transmission lines, and he also held other positions with that company before becoming assistant general manager, the office he has just resigned.

Frank L. Dame, vice-president of the North American Company and associated with the Harrison Williams organization, has been elected president of the Wisconsin Edison Company, Inc., which is controlled by the North American Company. Mr. Dame is also president of the Central States Electric Company, which controls the Cleveland (Ohio) Electric Illuminating Company, and a vice-president of the Cleveland Electric Illuminating Company and the Union Electric Light & Power Company, St. Louis, Mo. From 1909 to Jan. 1, 1913, he was vice-president of the Electric Bond & Share Company in charge of its operating department. His early connections with the industry were with the General Electric Company in the Pacific Northwest. Later he became general manager of the Union Electric Company, Dubuque, Iowa, after which he was appointed engineer for the Electrical Securities Corporation soon after its formation in 1904. He continued in that position until his election as a vice-president of the Electric Bond & Share Company in the fall of 1909, which position he resigned to become president of the Central States Electric Corporation.

F. L. DAME

A. E. Dyment, who has been elected president of the Canadian General Electric Company, Ltd., succeeding Senator Frederic Nicholls, who has become chairman of the board of directors, as announced on page 920 of last week's issue, is well known among Toronto financial men. For some years he has been a member of the stock brockerage house of Dyment, Cassels & Company. That connection he has given up, however, and he will make his headquarters at the offices of the Canadian General Electric Company. Mr. Dyment was formerly vice-president of the organization. He is also a director of the Royal Bank of Canada, director of the Mercantile Trust Company, director of the Dominion Sugar Company, vice-president of the Maritime Coal, Railways & Power Company and president of the Dyment Securities, Loan & Savings Company.

R. E. Fisher, who was recently placed in charge of the commercial department of the Pacific Gas & Electric Company, San Francisco, has for years been active in developing the use of electrical energy in the agricultural district of central and northern California. In addition to his regular duties, Mr. Fisher has found time materially to assist in the co-operative efforts between the several branches of the industry. His broad experience has well fitted him for the position of chairman of the Commercial Division of the Pacific Coast Section of the N. E. L. A., which he now holds. Mr. Fisher was born in Kansas in 1882, being taken as a child to Idaho, where, after completing high school, he began his electrical career. In 1902 he went to California, where he completed his technical education. After two years spent in operating a small station he became a salesman for the General Electric Company. Two

R. E. FISHER

years later he entered the electrical contracting business under the name of the Kurtz-Fisher Company. In 1909 he entered the newly formed Pacific States Electric Company, where he assisted in the organization and the development of sales policy. In 1911 he was employed by the Pacific Gas & Electric Company, and he had remained with that company to the present time. Mr. Fisher has been active for years in N. E. L. A. work and has served a term as president of the San Francisco Electric Development League, in addition to broad activities in civic bodies.

John F. Layng, for many years connected with the railway and traction engineering department of the General Electric Company, Schenectady, N. Y., has entered the consulting engineering field as a partner in the firm of Hemphill & Wells of New York City. Mr. Layng has been engaged in the electric railway business since 1889, having been at various times connected with operating companies, as well as with the General Electric Company and the Westinghouse Electric & Manufacturing Company. During the war he was engineer with the United States Fuel Administration in Washington, D. C., in charge of the electric railway fuel saving for the entire country. It was largely due to his efforts that the skip stop was so generally used.

Shiras Morris, president of the Hart & Hegeman Manufacturing Company, Hartford, Conn., has been elected president of the Johns-Pratt Company of that city to succeed the late Edward B. Hatch. Mr. Morris has been a director of the Johns-Pratt Company for a number of years. A brief biography of him appeared in the April 16, 1921, issue of the ELECTRICAL WORLD in connection with his election as president of the Associated Manufacturers of Electrical Supplies.

Arthur W. Fox, assistant treasurer of the Johns-Pratt Company, Hartford, Conn., has been appointed secretary of that company, to succeed Robert C. Buell, who has resigned to enter the stock brokerage business. No successor to Mr. Fox has been chosen.

Philip K. Murdock has been appointed export sales manager of the Bryant Electric Company, Bridgeport, Conn. Mr. Murdock was graduated from Dartmouth College in 1915, and after spending a year in the purchasing department of the Locomobile Company of America entered the Bryant organization as assistant to the sales service engineer. During the war he served in the First Separate Brigade of Coast Artillery, and upon returning to America he represented the Bryant interests in the metropolitan district and later in the South Atlantic seaboard states, with headquarters in Atlanta.

Lawrence P. Crecelius and **Victor B. Phillips** have announced the organization of the firm of Crecelius & Phillips, consulting, constructing and operating engineers, with offices in Cleveland. At the present time this firm is undertaking extensive work for large coal-mining interests which operate mines in Ohio, Pennsylvania and West Virginia. It is also acting as engineering counsel for a number of electric railways and other public utilities. Until recently Mr. Crecelius was electrical engineer and superintendent of power of the Cleveland Railway Company. He is a past-president of the American Electric Railway Engineering Association, a member of the American committee on electrolysis, of the committee on standards of the American Electric Railway Engineering Association and of a number of other engineering committees. Mr. Phillips has also until recently been associated with the Cleveland Railway Company, both as assistant to the vice-president and as acting superintendent of power. During the war he served with the 113th Engineers with the rank of captain. Subsequently he was attached to the American peace commission, being employed in the valuation of war damages, and later to the United States liquidation commission in charge of sales of surplus army stocks to Spain. Mr. Phillips is serving in the capacity of expert on the American committee on electrolysis. He is a member of the engineering executive committee of the National Safety Council.

J. P. Pulliam, in charge of the operation of the properties of the Wisconsin Securities Company, has been elected president of the Wisconsin Electrical Association. Mr. Pulliam has been connected with Wisconsin utilities for the last fourteen years. He is a native of Louisville, Ky., and for a time was connected with the Southern Railway at Louisville and with the Grand Rapids, Grand Haven & Muskegon Railway Company at Fruitport, Mich., as trainmaster. In 1907 he became superintendent of the Winnebago Traction Company, Oshkosh, Wis., and as the result of a reorganization his duties were extended to cover the operation of the Eastern Wisconsin Railway & Light Company, operator of the electric, gas and street-railway properties at Fond du Lac, with an interurban line to Oshkosh. When these properties were sold in April, 1917, Mr. Pulliam resigned and became affiliated with the

J. P. PULLIAM

Wisconsin Securities Company, Milwaukee. For six months in 1917 he was stationed at Green Bay as general manager of the Wisconsin Public Service Company. On Jan. 1, 1918, he assumed his present responsibilities.

Obituary

Lester Gray French, for thirteen years editor and manager of *Mechanical Engineering*, official journal of the American Society of Mechanical Engineers, of which he was assistant secretary, died April 18 at the French Hospital, New York City, after an operation. Mr. French was born in Keene, N. H., and was graduated from the Massachusetts Institute of Technology in 1891. He began his career as a draftsman with the Cranston Printing Trust Company and later was identified with engineering education. In 1897 he became editor-in-chief of *Machinery*, resigning in 1906 to publish technical books. He wrote one of the earliest American treatises on the steam turbine.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Slight Improvement in Interest in Electrical Sheets

AS THE year advances reports from manufacturers of electrical sheets show that the volume of inquiries is better now than it was last month, and that although the size of the orders is very small the number coming through is not so much below normal. Here and there an order is placed which is big enough to be remembered, but for the most part just enough sheet business is being placed to keep the electrical apparatus manufacturers working along on their reduced schedules of production.

There is plenty of the material that can be made available for quick delivery and no tendency to stock is noticeable on the part of manufacturers, jobbers or consumers. With the recent reduction in price on sheets by the Steel Corporation the price on electrical sheets for delivery up to July 1 is now generally on an even level for both corporation and independents. Certain mills that were below the general level came up to it when the corporation lowered its price. At this time it is impossible to predict the course of prices for delivery over the last six months of the year, and it will probably be late May or June before any price policy is made known. The opinion in the trade seems to be that electrical sheet business will have picked up considerably by fall.

Electrical Exports in March Total $9,782,045

ALTHOUGH the exports of electrical material and apparatus for the month of March showed a falling off to $9,782,045, this figure is nearly a million above that of a year ago March and brings the total for the first quarter of 1921 to $38,747,478. This shows an increase over the first quarter of 1920 of 73 per cent. Three items alone brought larger returns in March than in January or February—arc lamps, carbon-filament lamps and telegraph apparatus.

In spite of the optimistic feeling right along that electrical goods were leaving this country in satisfactory volume it is not surprising to find a recession in this volume from the extremely high values which have been shipped during the past five months. Current orders from beyond the borders are low in all classes of commodities, and consequently it would be rather unexpected if these high figures were even approached in the near future.

	March		Three Months Ended March	
	1920	1921	1920	1921
Batteries	$490,846	$412,019	$1,592,568	$1,519,487
Carbons	128,531	51,583	344,757	184,743
Dynamos and generators	414,178	550,562	1,240,811	1,954,630
Fans	115,069	179,939	224,436	847,756
Heating and cooking apparatus	135,450	180,693	389,289	853,981
Insulated wire and cable	543,546	721,647	1,772,424	4,293,174
Interior wiring supplies	230,315	200,096	594,718	999,651
Arc lamps	1,088	2,878	1,351	5,542
Carbon-filament lamps	19,986	20,435	36,865	44,314
Metal-filament lamps	427,348	296,177	1,002,436	1,514,528
Magnetos, spark plugs, etc.	444,240	112,534	957,658	575,947
Meters and measuring instruments	207,655	254,029	615,242	1,028,612
Motors	1,247,806	1,571,601	2,807,355	6,062,458
Rheostats and controllers	72,896	87,649	177,936	363,137
Switches and accessories	356,631	429,118	1,031,870	1,889,930
Telegraph apparatus	61,530	352,714	261,684	508,456
Telephones	414,451	499,072	898,094	1,978,247
Transformers	347,195	765,564	992,744	3,011,417
All others	2,966,103	3,093,735	6,863,312	11,111,468
Total	$8,874,884	$9,782,045	$21,805,549	$38,747,478

One of the main reasons for this feeling is that the value paid for electrical goods has decreased since last fall so that even with a continuance of orders the amount would be lower for the same volume. Furthermore, it was last summer and fall when domestic business began to drop off. Manufacturers then were able to concentrate production on foreign orders, and shipments out of the country improved materially. This increase was noticed very markedly in the electrical exports from October on through February, the highest months on record.

Looking forward, it is known that there are developments in Italy, Sweden, Switzerland and other European states which will be put under way this year, while, on the other hand, there are some which will not come through in 1921. Japan and other Far Eastern countries have projects which probably will be let this year. There is no doubt that the present lull in export buying is only temporary, but although the future is bright it will mean real selling efforts to overcome foreign competition.

Some Trends in Lighting Fixture Design

IN THE design and execution of lighting fixtures, especially for residential and hotel use, there is a very noticeable trend toward certain rather distinctive features. This is particularly true of the higher class of fixtures and was borne out strongly at the fixture convention in Buffalo in February. Although many manufacturers of these fixtures will not admit it, there certainly appears to be a decided leaning toward fixtures using exposed round-type lamps and candelabra effects with or without shades. In the cheaper class of fixture the employment of glassware is still adhered to strongly.

Color and decorative effect predominate. In the last year there have been developed many new finishes for the metals, and these are being used in matching general color designs of the rooms. Some colored pottery vase effects are being worked in to the fixture proper. There are also colored flowers and drops attached or hung here and there. Sometimes these are of glass and sometimes of metal. Crystal and prisms seem to be quite popular in the highest grade of residential and hotel fixtures.

Where glassware is used it is gradually tending to be of higher quality and is taking on a more decorative effect.

Demand for Line Materials Slow in Materializing

IN SPITE of the admittedly low price of copper and the varying reductions which lately have gone into effect on other materials entering into line construction, reports come from the Mid-West that the season of the year which usually sees the heaviest purchasing of these materials is passing without much being done. Construction by central stations is being pared down to pressing needs.

There are several angles to this problem, two of the most prominent being the high price of money and the high price of materials. It is useless to expect central-station operators to pay 8 per cent for money to put into electric utility property, the value of which in the process of readjustment is apt to be lowered 20 to 30 per cent in the next three years. A large part of the extension work done in the past has been done because the community needed the service and not because the central-station company expected an immediate return on its investment; but in the present money market ample returns must be assured before it is wise or even possible to obtain capital for a new line. Nor is this

a situation which may be expected to mend quickly, according to the heads of some of the largest utilities in the Middle West. It is their opinion that the old reservoir of capital, the money minority, has been tapped almost to the limit and that from now on the public as a whole must be educated to support the utilities. This means a long, slow, painful process.

One hope for getting the tremendous construction program started is for prices to recede to the point where it will be reasonable to expect central-station companies to put 8 per cent money into generating plants and transmission and distribution lines. Or else money must go lower. It is the average opinion that, with the exception of copper, prices have not reached the low point yet. Copper today is below its pre-war price, but the demand for it is so enmeshed with the demand for other materials that this fact has not induced much buying.

What some central-station companies are expecting in the way of reduced prices may be seen from a comparison of the line costs of one large utility company in the Middle West for the years 1917, 1918, 1919, 1920 and the first three months of 1921. Taking the costs for 1917 as a base, with a value of 100 per cent, these figures show that in 1918 materials went up to 106¾ per cent, labor up to 101¼ per cent and the total cost of construction, excluding right-of-way, up to 105¼ per cent. In 1919 materials increased to 140 per cent, labor to 121 per cent and total cost to 134 per cent. In the peak year, 1920, materials had risen to 156 per cent, labor to 172½ per cent and total cost to 160¼ per cent. At present materials are down to 132 per cent, a reduction of 15 per cent from 1920, and total cost has receded to 142 per cent, or an 11⅛ per cent reduction from the preceding year, while labor continues at its 1920 level.

Labor cost at present amounts to 30 per cent of the total against 25 per cent in 1917. There is a probability that wages will be reduced a trifle, but the main desire of the utilities is that material costs be reduced approximately 25 per cent further, bringing them to about the 1917 level. Whether manufacturers can afford this at present is another problem. On the average line in 1917 copper formed about 50 per cent of the total material cost, while at present it forms only about 30 per cent. Were this item to regain its 1917 level other materials would have to drop about 45 per cent to equalize matters. So far copper has borne most of the burden of deflation, a condition that is neither economically just nor safe. To remedy it means an immediate sacrifice, but an ultimate greater benefit to the whole industry. Against this is balanced the possibility of getting cheaper money, and in the solution there may be a compromise whereby materials and money will find lowered costs.

Appliance Sales Responding to Aggressive Merchandising in Southwest

THE experiences of several central stations in the Southwest seem to point out that a good market for appliances still exists there, provided that the proper merchandising methods are applied. Sales of appliances of all sorts fell off somewhat during January, February and the first half of March as compared with the same period in 1920, but this drop in sales has not been so marked in the case of companies employing aggressive sales methods as it has been in other instances. Again, the further into the Southwest the investigation was carried the better were the conditions found.

One central station in the far Southwest reports that during January sales of appliances totaled 50 per cent more than in January, 1920, and that February sales ran slightly ahead of those for February, 1920. At least 90 per cent of their sales, according to the manager of appliance sales, can be attributed to the fact that salesmen impressed the "household necessity" idea upon each customer and put forth an effort to sell appliances instead of merely taking orders as has been done for the last couple of years. Other companies have had similar experiences. In the more eastern section of the territory agricultural and industrial conditions have affected sales to a greater extent, decreases from the like period in 1920 running from 15 per cent to 50 per cent.

Discarding the dollar sales value of the various appliances and taking into consideration only the number of items sold the following seems to be an average ranking: Domestic irons, cleaners, washing machines, percolators, portable heaters, grills, curling irons, toasters, heating pads and sewing machines. It is reported from some districts that washing-machine sales are running ahead of those of vacuum cleaners.

Price inducements have been tried occasionally with good results. Some tendency to balk at price has been shown by the public, and where in conjunction with aggressive merchandising a slight concession has been made sales have increased largely. One central station by using these methods in a washing-machine campaign increased its sales for the three-week period of the campaign 650 per cent over the same period in 1920.

Survey Shows Use of Socket Appliances in Canada

IN THE matter of distribution of socket appliances in Canada, a summary of the electrical needs of more than 250 Canadian towns and cities distributed from coast to coast, according to the *Electrical News*, Toronto, Canada, indicates only 7.3 per cent saturation on the average. The sales opportunities here are pointed out very definitely.

Houses wired showed 74.9 per cent, but the degree of utilization of socket devices seemed remarkably low. Flatirons showed 45.7 per cent, toasters 18.2, washing machines 5.9, fans 5.4, vacuum cleaners 5, air heaters 4.8, percolaters 3.7, ranges 3.1, water heaters 1.3, sewing-machine motors 1.2, ironing machines 0.14, dishwashers 0.07 and refrigerators 0.06 per cent.

The Metal Market Situation

THE best that can be said for the copper market is that large producers are still maintaining their prices. Buying interest in general is lacking despite occasional orders that stand out, such as that of the Western Union Telegraph Company for 3,000,000 lb. last week. Japan has come into the market again for the first time in many months, but orders from that quarter are not important as yet.

As the statistical position of copper continues to improve producers are hopeful that in about two months more the commercial position will open up too, but right now consumers, including wire producers and manufacturers of brass products, show little interest. Continued slack demand has had the effect of making some of the smaller interests willing to shade the asking price of 12.75 cents per pound for prompt shipment, and reports persist that as low as 12.50 cents has been quoted on small lots. The majority of producers continue to ask from 12.75 to 13 cents over the second quarter, however. In the outside market there is very little copper available, and virtually none at all under 12.75 cents delivered.

Demand for lead is not especially large, but the market is firm at the "official" price of 4.35 cents per pound. Galvanizers have been buying zinc recently, and consequently there has been an advance during the week, though surplus stocks are still too large. The scrap-metals market is quiet.

NEW YORK METAL MARKET PRICE

	April 19, 1921	April 26, 1921
Copper	£ s d	£ s d
London, standard spot	69 15 0	70 5 0
	Cents per Pound	Cents per Pound
Prime Lake	12.75—13.00	12.75—13.00
Electrolytic	12.75	12.75
Casting	11.75—12.00	11.62½
Wire base	14.50—15.00	14.50—15.00
Lead, trust price	4.25	4.35
Antimony	5.12	5.25
Nickel, Ingot	41.00	41.00
Sheet zinc, f.o.b. smelter	11.00	11.00
Zinc, spot	5.20	5.45
Tin	30.75	32.00
Aluminum, 98 to 99 per cent	28.00	28.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	9.50—10.25	9.50—10.25
Brass, heavy	5.50— 5.75	5.50— 5.75
Brass, light	3.75— 4.00	3.75— 4.00
Lead, heavy	3.50— 3.75	3.50— 3.75
Zinc, old scrap	2.87½— 3.00	2.87½— 3.00

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

WHILE there is little marked improvement in general supply business there is, however, that steadily though gradually increasing tone to the market which points to a healthy condition of trading when it shall have progressed somewhat further. New England business is holding up reasonably well, and central stations and traction companies are a little more active. Midwest business is unchanged, and in Chicago the building labor deadlock is holding up construction projects. In the South Central States there are small increases in sales and better railroad buying. An effort is being made there to stimulate Mexican business.

Small-residence building in the South Atlantic States is fair, and farmers are releasing cotton and other products in rural districts. Building is good in the Intermountain territory and manufacturers' agencies report better business there. Northwest lumbering is a little more active and some other industries are waking up a little. Building is poor. Collections are improved on the West Coast.

A threatened marine tie-up may still further hamper shipments out of this country; general transportation is good, however.

NEW YORK

There is not much increase in the total volume of sales of jobbers. These would like to report better business if they could, and hence the majority are optimistic, but truth compels the acknowledgment of the present quiet state of affairs. There is a barely perceptible improvement in some quarters, and by July, it is generally hoped, business will be on its feet again. Just now attention is devoted to cutting down overhead. This has been accomplished by releasing chiefly office help and in some cases a few salesmen where the latter are not on a commission basis, and also in a couple of instances by wage cuts.

Lower prices are reported on outlet boxes, and there is also a slight drop on armored cable. Price decreases are little or no stimulus to trade, however.

Conduit.—There is some fairly steady demand in very small lots that seems to indicate a maintenance call, but the bulk of the good stocks that are held is not moving. Many jobbers as yet have not changed prices very materially since the recent manufacturers' drop, quotations this week on 2,500 ft. being as follows: ½-in. black, $63.50 to $68; ½-in. galvanized, $68.70 to $78; 1-in. black, $123.75 to $129; 1-in. galvanized, $134 to $139 per 1,000 ft.

Cast-Iron Bodies.—A full assortment of condulets, etc., is generally carried, but supplies are not moving well. In standard-package quantities 15 per cent off list is quoted on condulets.

Flexible Armored Conductor.—Demand is small, with good stocks on hand. A leading manufacturer this week reduced the Pittsburgh base price of double-strip $2 per 1,000 ft. to the same level as single-strip material, or $55. Jobbers sell 1,000 ft. of No. 14, two-wire, double-strip, at $59 to $65.

Porcelain.—Prices cover a wide range, representative quotations this week being $25.20 to $30 on "Nail-it" knobs, $10.35 to $12 on 3-in. x ⅞-in. tubes and $15 to $26 on two-wire unglazed cleats, all in barrel lots per thousand. The market is stagnant, with fairly small stocks held.

Outlet Boxes.—Following the corporation drop in steel prices manufacturers have generally reduced stamped-steel boxes by increasing the discount allowed on both black and galvanized ten points. The drop is effective on varying dates, ranging from April 21 to 25 in several instances. Previous discounts quoted by jobbers ranged from 35 to 40 per cent on black and 30 to 35 per cent on galvanized in lots of 100. Demand is slow, with fair stocks held.

Lead-Covered Wire.—Little or no call is received for this product, so only small stocks are carried. No. 14 duplex in 1,000-ft. lots brings from $35 to $42 per 1,000 ft.

Schedule Material.—Demand is poor and jobbers are still in some cases replenishing stocks from one another rather than from manufacturers.

Fans.—The market is spotty, as some jobbers report a pretty fair demand and a good increase in sales in view of present warm weather; some say demand is just starting to show improvement, while others report no activity at all as yet. The general fan policy this year, it seems, will be to let the manufacturer "hold the bag."

Flashlights.—Jobbers report no activity in expectation of a vacation demand as yet; in fact the market is quiet, with fair stocks on hand.

CHICAGO

The immediate future of construction in this territory remains uncertain for, following the rejection by the unions of the newly offered scale carrying a reduction of from 20 to 30 per cent, the employers' associations have issued an ultimatum to labor. Their position is that unless the unions reconsider and sign up at the new scale a lockout on all construction work will go into immediate effect.

Business is virtually unchanged. Insulated wire is lower in price because it was too high in comparison with prices of bare copper and bar copper. Western cedar poles are down considerably below Northerns and little business is reported in either kind. Black conduit, following steel, is off a little, building inactivity continuing to act as a brake on sales.

Bare Copper Wire.—The momentary strength shown a week ago has been entirely dissipated. The larger distributers have made no change in price for several weeks, and the passing upward tendency was noted only in less willingness to shade prices by some smaller interests.

Insulated Copper Wire.—An effect of the long-continued low price of copper has been to cause another reduction in insulated wire. No. 14 rubber-covered in 10,000-ft. lots is now quoted at $7 per 1,000 ft. No. 6 triple-braid weatherproof is 17 cents per pound in quantities of 1,000 lb. These reductions are in line with lower insulating materials.

Flexible Armored Conductor.—This commodity holds firm, ample in supply and with demand light. It is stated that present prices have anticipated recent reductions in production costs. No. 14, two-wire, in 5,000-ft. lots, is quoted at $62 per 1,000 ft.

Black Conduit.—Reductions in steel have induced new lists showing a slight cut. Beginning April 25 a price of $62 per 1,000 ft. is quoted on ½-in. in 5,000-lb. lots. Demand is very quiet.

Poles.—In line with lowered producing costs on the Western coast and with readjusted freight charges new lists on Western cedar poles are in preparation. Reductions are expected to average 15 per cent. Northern poles remain unchanged in price. Producers claim that the season's short production precludes any thought of a cut. Business is light.

Line Hardware.—Recent changes in the price of raw materials have not caused any changes in hardware lists. Lowered steel costs were anticipated when the current lists were in preparation.

Hollow Ware.—Retailers still complain that prices are too high. Their sales in most cases are scarce, and as a result jobbers report business as poor.

Toasters and Flatirons.—Flatirons remain the one fairly steady item in the retail stores. As an indication that price has little effect on the trade it is noted that a ten-dollar iron is selling more rapidly than other makes which are priced from $1.50 to $2 cheaper. Toasters have retained a portion of their popularity, but are moving much slower than the trade would like.

BOSTON

Business held up reasonably well last week, and the contracts placed in New England building and engineering operations for the week ended April 18 totaled $4,409,200, compared with $4,724,000 for the same period last year. Jobbers and retailers continue to buy from hand to mouth, but increased sales of wiring material are anticipated before long. Central stations are coming more actively into the market for pole-line material, and some inquiries are being made by electric railways with resultant small orders. The open-shop movement appears to be gaining headway. Collections are being sharply watched. Stocks are ample for present needs, and the only long deliveries are on high-tension insulators. Prices show a tendency to weaken in flexible armored conductor and rigid conduit.

Flexible Armored Conductor.—Prices are unsteady in competitive sales, ranging from $60 to $65 in typical cases on No. 14 double-strip, per 1,000 ft., in 5,000-ft. lots. Sales are not active, however, and the desire to move stocks is apparently behind these price variations.

Rigid Conduit.—Stocks are plentiful and an abundance of all sizes is in evidence. Prices are settling into the new levels announced last week, and in 5,000-lb. orders the following are typical: Black pipe, ½-in., $67.30, galvanized, $72.40 per 1,000 ft.; black, 1-in., $131.20, and galvanized, 1-in., $141.40. Movement is quiet.

Sockets.—Steady prices feature the market with ample stocks for current requirements. These are still moderate. Pulls in case lots bring 47½ cents net, and keys and keyless 27 and 26 to 25 cents.

Wire.—Rubber-covered No. 14 is selling at $7.50 per 1,000 ft. on 5,000-ft. orders. Weatherproof is selling on from 16 to 17 cents base, with ample stocks. Bare copper wire is being marketed on base prices ranging from 14¾ to 15½ cents. Central-station buying accounts for some business.

Non-Metallic Flexible Conduit.—As yet this material shows no acceleration in general sales movement.

Friction Tape.—Prices are showing some variation, depending largely on the qualities marketed. In 100-lb lots good grades bring from 45 to 50 cents per pound, ¾-in. black and job lots sell around 30 cents. The demand is very sluggish.

Motors.—An excess of motors appears to be the usual situation in distributing circles. Some new power business is being taken on by central stations and a good many motors are being sold when it is realized that the business is spread out very thinly.

Industrial Heating.—Interest in this class of equipment is growing steadily, and intensified efforts to develop a broader market are being planned for early pushing by manufacturing and central-station interests. Missionary work is beginning to bear fruit in selective sales.

Appliances.—Popular interest and trade are being stimulated by marketing a good many designs of substantial but not the latest type at low prices in retail stores. In purchasing these the public seems to accept higher quotations on the most advanced designs with less objection than where only the latest products are shown. Interest in irons, washers and cleaners continues active.

Knobs and Tubes.—In barrel lots "Nail-it" knobs sell for $27 per 1,000 and 3-in. tubes for $9.50 per 1,000. Light demand is reported.

ATLANTA

Business in this section as a whole might be said to be rather quiet, though one or two of the more fortunate centers report conditions holding up fairly well. The principal activity reported seems to be that resulting from the purchase of material required for electrical installations in small residences, repairs caused by fire damage and improvements urgently needed to existing industrial plants. The municipal activity, which a few weeks ago was fairly good, has again become dormant and few orders for pole-line material and allied lines are being received. Retail electrical dealers seem very slow to replace depleted stocks of household appliances, largely on account of their difficulty in interesting the buying public in this line of goods. Fans, however, continue to live up to dealers' expectations.

There is a noticeable tendency on the part of the rural population to release their farm products, particularly cotton, which is beginning to move much more freely, with the result that Southern banks are able to reduce materially the amount of outstanding loans. This should serve to make money easier for industrial and commercial activities. Building permits in Atlanta continue to hold up fairly well, there being a noticeable increase in the number of permits taken out for small residential construction. Jobbers report their collections slightly improved over those a month ago.

Wire.—A further reduction in the price of wire is reported this week, rubber-covered No. 14 being quoted at $8 per 1,000 ft. and No. 12 at $10. The rubber-covered seems to be moving more satisfactorily than weatherprooof, orders for the latter variety being small in volume. Stocks are reported in excellent condition.

Storage Batteries.—These have not responded to the seasonal movement. Distributers have heavy stocks on hand in virtually all sizes.

Schedule Material.—The construction of small residences and repairs to damaged buildings has served to accelerate the movement of this line. Stocks are in good shape. "Nail-it" knobs, standard packages, are $2.83 per 100; porcelain tubes, $\frac{5}{16}$ in. x 3 in., are $1.08 per 100; pendent key sockets are 28 cents each; single-pole snap switches are 27 cents each, and push-button switches, single-pole, 29 cents.

Washing Machines.—The movement is not by any means satisfactory. Like other lines of household appliances the market is very dull. Heavy stocks are reported on hand by nearly all jobbing firms.

Outlet and Switch Boxes.—The demand is reported as above the average, while stocks continue to be maintained in good condition, with no price change to be noted.

Interphones and Call Systems.—Considerable activity is reported, the construction of an unusual number of hospitals being responsible for the brisk movement in call systems, while interphones are going into apartment houses nearing completion. Stocks of interphones are quite satisfactory, with shipments on call systems good.

Printing-Press Apparatus.—A quite widespread activity is noted throughout the entire line of electrical equipment for printing establishments, the principal demand being for small to medium-size units. Local stocks are somewhat spotty and shipments range from stock to eight weeks.

Industrial Motors.—Interest is showing a slight improvement over prior weeks, though orders approximate only 30 per cent of the normal four-year average. The three-phase, 220-volt type seems to be the most popular. Stocks are in fair condition, with single-phase motors being reported again as having returned to normal stock basis.

ST. LOUIS

No deviation in the progress toward better business was observed this week. Sales are gradually increasing in volume, and business, while by no means normal, has generally a better tone. More confidence in the future is manifest. Two of the largest stove factories in St. Louis reopened this week after shutdowns of four months. No large orders are now on the books, but preparations are being made for the fall demand, which is expected to be at least 50 per cent of normal. The railroads have been doing more buying lately than for several months previously. Some new construction work has been started, but only a small portion of this is industrial. A number of industrial plants are making inquiries, however, and it is expected that industrial building will show improvement by fall. Very few industrial plants are entirely closed down, and the average operation is on a four-day-per-week basis. In special cases, as in manufacturing women's shoes, the plants are running on full basis.

Active efforts are being made by St. Louis concerns to stimulate business. Delegations have been sent to Mexico and Mexican delegations have visited here to foster better business relations. There is an attractive amount of trade

with Mexico, and it is felt that the recent conferences will increase it. To stimulate building, particularly of residences, the "Own Your Home" Exposition opened April 25 for one week.

Collections are still on an average basis of sixty days, but electrical jobbers have their obligations well in hand, so that the time required for collections is giving no material concern. The tendency is to stop price cutting except where replacement prices are reduced, as it is found that lower prices have no material effect upon buying.

Poles and Crossarms.—The reduction in prices announced last week has not yet resulted in an appreciable increase in orders, but inquiries are numerous and attractive orders are expected before long. Local stocks are in good condition.

Porcelain Insulators.—Prices are firm and deliveries are much improved. Factory shipments in some kinds can be made immediately and the other kinds can be shipped in not exceeding thirty days.

Dry Cells.—Sales are reported to be on a normal basis and local stocks are in good condition. Immediate factory shipment is available. In barrel lots the regular cell sells at 38 cents each and the igniter sells at 39 cents each.

Wire.—Rubber-covered continues to have a competitive market and No. 14 is the leader. The price on No. 14 varies from $7 to $8 per 1,000 ft., depending upon how badly the individual jobber wishes to reduce his inventory. The larger sizes are moving quite slowly. Only a small demand is found for bare and weatherproof.

Knobs and Tubes.—"Nail-it" knobs are selling from $23.80 to $28 per 1,000, and 2½-in. tubes at $8 to $8.75 per 1,000. The demand is quite low and the stocks heavy.

Vacuum Cleaners.—Improvement in demand is noticed, due to the usual spring requirements. Intensive sales efforts are being applied which are resulting in sales not far from normal for residential requirements. The demand for cleaners in office buildings and apartments is very quiet.

Flexible Armored Conductor.—Slight improvement in demand for the week is reported, but sales are still low and stocks are somewhat heavy. No. 14 double-strip is quoted as a rule at $65 per 1,000 ft. in 5,000-ft. lots, but some quotations are made as high as $80.

SAN FRANCISCO

Collections are better than those of a month ago, particularly in the larger cities. Country dealers, however, are still running slower than those in the city. They are being helpfully followed, although as a rule the credit situation is rather tighter than it was last year, with small encouragement offered new enterprises unless they are gilt-edged.

During the recent highly successful San Francisco market week, in which the dealers from all over the Pacific Coast were induced to visit San Francisco to inspect new stocks, orders to the value of several million dollars were placed. While the electrical industry did not participate directly, it will benefit from the general prosperity of the community.

Rail shipments are coming through from Eastern factories in very good time, carload shipments requiring about twenty days and less-than-carload shipments thirty days. It is estimated that the present volume of freight received is about 70 per cent of that of 1920.

Household Devices.—Beginning with the middle of March the growing business of household appliances was seriously affected by the indifference of the buying public, who are either jaded by present soliciting methods or are confidently expecting much lower prices. Dealers are cutting their stocks to a minimum and are particularly retrenching on conditions of purchase affecting their turnover rate, such as unusual quantities and parallel makes. One of the jobbers (Pacific States Electric Company) is instituting a series of merchandising conferences to be effective along the entire Pacific Coast during May, to which the electrical merchandising fraternity is invited. Washers are particularly slow, and vacuum cleaners, except those sold through large department-store campaigns, are hardly better. On the other hand, such comparatively new lines as ironers and dishwashers are showing a pretty good movement.

SEATTLE—PORTLAND

Trade and industry in the Seattle and Portland fields, according to recent reports and present indications, do not reflect any marked changes from last reports, but there are enough signs of improvement in basic conditions to rob the general showing of some of its hitherto rather depressing atmosphere. Industry, particularly lumbering, is a trifle more active, but it is more or less depressed owing to slack buying and unstable prices. Camp and mill activities are still on a 50 per cent basis as regards numbers in operation and nearly all are operating on a reduced-capacity basis. The employment situation is improving from week to week, and the demand for construction, building and general laborers during the past week showed excellent improvement. Manufacturers state that there seems to be a feeling of a little more confidence abroad at present, although it is no more than barely perceptible. Business continues about the same.

There have been no recent price changes of note and stocks of all kinds are in good shape. Jobbers throughout the district, as a whole, state there is a continued increase in business, although it is still not of very great value. There is no improvement in collections, particularly in the Portland field, and it is expected that the next two or three months may record several liquidations of smaller organizations that are operating on an unsound financial basis. Those operating on a sound basis, but temporarily embarrassed, are having time extensions granted them. Contracting business in both Seattle and Portland is active in small work, but there is practically nothing in the way of larger contracts. In Portland residence fixture business is active, but in Seattle it is only fair.

Insulated Wire.—Very light business is reported in inside wire in Seattle, but the Portland field reports increasing sales volumes. Stocks of all sizes are ample and prices are subject to some variation.

Lamps.—Jobbers and dealers report present demand is not far from normal for this time of year.

Motors.—Inquiries are light but are on the increase and some small sales are being handled. Considerable interest is being shown in motor application, and it is believed that this interest will develop into orders of consequence later in the year.

Distribution Transformers.—Accompanying the movement of pole-line material, transformer sales are reported increasing, smaller municipalities, especially, doing considerable buying. Stocks are in good condition.

Safety Switches.—Demand continues comparatively brisk, stocks, generally speaking, are in good shape and replenishments are coming through satisfactorily.

Conduit.—Demand, particularly in the Portland field, is showing an increase, with residence building on the upward trend. In Seattle the demand shows slight improvement.

SALT LAKE CITY—DENVER

Much building activity is reported in the territory of Denver and $15,000,000 worth of buildings is now projected for the year 1921. These structures include several large office buildings. This activity in the Denver territory is about typical of the general building status in the Intermountain region. Several large manufacturers' agencies report business better at the present time than in the corresponding period of 1919.

A co-operative league movement has been launched in Denver, taking in twenty-five manufacturers, forty dealers, several jobbers and the central stations. The movement is well under way and is characterized by much enthusiasm. The backward spring is holding up building operations to some extent and is having a similar depressing effect on business generally. Farmers are a little behind schedule in planting their crops. They report labor both cheap and plentiful. The employment situation is not much changed. There are perhaps more men unemployed at the present time than at any period during the siege of non-employment. Indications, however, point to early alleviation of this difficulty. Collections are still slow.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

New Driver-Harris Bonds for Expansion

Of an authorized $2,000,000 of these bonds the Driver-Harris Company, Harrison, N. J., has placed on the market $1,250,000 of first mortgage 8 per cent gold bonds, due April 1, 1931. The price is 99½ and interest, denominations are $500 and $1,000, and they are redeemable at the company's option at from 107 to 104, plus accrued interest, depending on the year in which they may be taken up from 1921 to 1931.

The purpose of the issue, according to Frank L. Driver, president, is for the erection and equipment of a new hot-rolling mill and for additional working capital required by the steadily increasing business of the company. Besides its holdings in this country the company has found it necessary to erect plants in Canada, England and France.

Vacuum-Cleaner Maker Adds Furnace Plant

The Ramey Manufacturing Company, Columbus, Ohio, has purchased the F. B. Zieg Manufacturing Company, Fredericktown, Ohio, its heater-furnace business and equipment, and has moved this plant to Columbus, where it will be operated together with the company's vacuum-cleaner business at 175-179 West Fulton Street.

Change in Name to Brunt Porcelain Company

Having discontinued the manufacture of tile, the Brunt Porcelain Company is successor to the Brunt Tile & Porcelain Company, Columbus, Ohio. The company specializes on knobs, tubes and cleats and about the first of the year added two new kilns and three new buildings, giving a total floor space now occupied of 70,766 sq.ft. Building depression just now, of course, is making the porcelain industry quiet, but the company is receiving a healthy proportion of business.

Ohio Brass Insulator Business Holds Up Strongly

The Ohio Brass Company, Mansfield, Ohio, reports that new orders for high-tension insulators hold up surprisingly well in view of the quiet condition of the general electrical market. Foreign shipments the first quarter of this year were exceptionally large, it is stated, and new business from abroad continues in good volume. In general, the company is still sixty to ninety days behind on orders, though the insulator plant is running at full capacity with an undiminished labor force. Pin-type insulators and bushings are in the worst shape as regards delivery, while a fair reserve supply of suspension units is reported to be on hand. One of the most recent orders of the company is that just placed by the Ohio Power Company for 8,000 suspension units covering a 15-mile line at 66,000 volts. Shipment of these insulators will start within the next two weeks.

Western Electric's Dealer Help in Power and Light Plant Sales

In going out after the six and one-half million farms in the United States and Canada, of which about one-half million have electric service from central-station and farm plants, the Western Electric Company has just issued a special advertising manual for its power and light dealers. Contained in this "Business Builders for 1921" is a special 104-page booklet designed to assist dealers in the development of their local newspaper advertising. News stories and advertisements are tied up together for each week in the year.

Appleton Electric Buys Nicholson Connector

The Appleton Electric Company, 1701-13 Wellington Avenue, Chicago, has purchased all patents, machinery, etc., for manufacturing the box connector for metallic flexible conduit formerly made by the Nicholson Electric Fittings Company, Wilkes-Barre, Pa.

Standardization to Be Discussed by Gear Manufacturers

The fifth annual meeting of the American Gear Manufacturers' Association is being held in the Hotel Sinton, Cincinnati, Ohio, April 27, 28, 29 and 30. Standardization and uniform cost accounting will be among the subjects discussed, and important action is expected by the association tending toward the establishment of a more complete standardization of the products of the gear industry.

According to the program that has been prepared G. M. Bartlett of the Diamond Chain & Manufacturing Company will discuss "The Ideal Chain and Sprocket Drive"; A. R. Mitchell of the Andrews Steel Company will speak on "Industrial Gears from the User's Standpoint"; J. B. Foote, president Foote Brothers' Gear & Machine Company, has been assigned "Worm Gearing," and J. B. Doan, president American Tool Works, has an unannounced subject.

Maintenance Company Moves to Larger Building

The Maintenance Company has moved from 417 Canal Street, New York City, to the building at 449-453 West Forty-second Street, where it has about double the room it formerly had to carry on its electrical contracting, retailing of supplies, repair and maintenance of power and lighting equipment and systems. The building is 60 ft. x 90 ft., and the company now is using the basement, ground and first floors. Number 455, next door, has just been purchased by the company and will be rented out for the time being.

Sager Electrical Takes Over J. W. Poole & Company

The Sager Electrical Supply Company has been organized at Boston to take over the business and distributing agencies handled by James W. Poole & Company, Inc., with offices and stockrooms at 201 Congress Street. Joseph E. Sager is president and treasurer of the company, George Lloyd being sales manager and W. M. Fyffe purchasing agent. The Poole company was one of the older jobbers of New England and the Sager interests acquired the business following the death of the late James W. Poole.

Rome Wire's New Weatherproof Wire Mill in Operation

The Rome Wire Company, Rome, N. Y., has added weatherproof wire to its manufacturing schedule, and its new weatherproof wire mill is now completed and in operation. This plant is two stories in height, 125 ft. x 325 ft., with floor space of 81,250 sq.ft., bringing the company's total floor space to 15½ acres. The new product rounds out the company's line of copper rods, bare and tinned copper wire, stranded cables, rubber-covered wires, magnet wires and weatherproof wires. It is the intention to carry large stocks of rubber-covered and weatherproof wires in the Rome warehouses at all times.

American Di-Electrics Enlarging Quarters and Distribution

American Di-Electrics, Ltd., New York City, manufacturers and engineers in the field of insulation, are moving to larger quarters at 71-73 West Broadway on May 1. John P. Rockwood, metropolitan distributer, is also moving to the same address. The change will enable the company to enlarge its lines and deal in all kinds of insulation in addition to those produced in its own factories. The company's Pittsburgh agent, the Electrical Engineering & Manufacturing Company, has also recently moved to larger quarters at 907-909 Penn Avenue, Pittsburgh.

Surf Washer Taken Over by Sunbeam Domestic

The Surf Manufacturing Company, manufacturer of the Surf electric clothes washers, has been taken over by the Sunbeam Domestic Appliance Company of Evansville, Ind., and will move into its new daylight factory in Evansville some time in May. The new company will retain the trade name of "surf" and will be under the active management of O. F. Fischedick, formerly of the Surf Manufacturing Company.

It is announced that the change will enable the new company to manufacture its product under more favorable conditions both as to additional capital and lower labor costs.

Franco Electric Moving Into Larger Quarters

The Franco Electric Corporation, manufacturer of flashlights, flashlight batteries, Christmas-tree outfits and novelties, is now moving from its former location on South Fourth Street to its new factory and office building at Tillary and Pearl Streets, Brooklyn, N. Y. This new "Franco" building is of six stories and basement and contains 120,000 sq.ft., whereas the former location provided only 75,000 sq.ft. of space. Occupancy is expected to be completed by May 15.

On advices from the company, business for the first quarter of this year amounted to 15 to 20 per cent more than that of the same period of 1920, and, except for the break caused by moving, the volume of present business is very satisfactory. Full capacity is expected by August.

Cancellations Reduced Through Active Production

In a message to employees of the Lynn (Mass.) works of the General Electric Company Manager Richard H. Rice points out that at no time in the history of the plant has close co-operation between the management and the employees been so necessary as it is today and that the response of the employees to a previous suggestion that increased vigor of production would enable deliveries to be maintained and minimize cancellations has been heartening. "The Lynn works has been singularly favored," said Mr. Rice, "in being able to keep on with the force reduced only a small percentage from the maximum and with most departments running full time. We still have considerable volumes of unfilled orders on our books, and the same process of intensified production on these orders is necessary if we are to keep our customers. While it is true that we have had large cancellations of orders, these cancellations have been insignificant in amount as compared with those which we would have had if we had greatly delayed the shipment of our apparatus."

In referring to the efforts being made by the management to minimize layoffs Mr. Rice points out that the number of employees absent from the plant on Saturday mornings all through 1920 was virtually equal to the number now laid off for lack of work. This large absentee list, he said, indicated a serious failure to realize the necessities of either the plant or of individual thrift. Through co-operation, it is believed, the present depression can be faced with confidence.

Motor Plant Begins Operation in Louisville

Electric motors and generators and other electric machinery are now being manufactured by the Louisville Electric Company, Louisville, Ky. The company was organized by Charles E. Willey, president, and James F. Willey. It has been incorporated and recently completed its new factory at Thirty-first and Magazine Streets. This is 65 ft. x 150 ft.

The company, while manufacturing motors, generators and electric-driven tools, will make a specialty of repairing electric machinery.

Jobber Urges Divorce of Dealer and Contractor

The results of the electric range demonstration held by the Piedmont Electric Company, Asheville, N. C., in March have been pleasingly evidenced through the company's retail department, according to William Farr, president and general manager, and hardly a day goes by but that some lady who attended the demonstration orders a range.

The dealers, however, are found neglectful of the opportunity to stir up business in their own towns. This Mr. Farr considers to be the weak link in the selling chain at present, and he is convinced that before any real results are obtained in the sale of electrical merchandise through the dealer he will have to separate his business from contracting. Even in the small towns Mr. Farr thinks there is room for two men to devote their entire time to the merchandising of electrical goods, others to do contracting and installation of such equipment.

Stoker Producers' Annual Meeting Date Changed

Because of conflicting dates with meetings of other societies, the Stoker Manufacturers' Association, J. G. Worker secretary, Phoenix Manufacturing Company, Eau Claire, Wis., has changed the date of its annual conference to June 14, 15 and 16 at the Red Lion Inn, Stockbridge, Mass. The program is not yet in a completed stage.

The British-American Metals Company, Inc., will move its general offices from 52 Vanderbilt Avenue to larger quarters at 200 Broadway, New York City, about May 2.

The Green Fuel Economizer Company about May 1 will move its general sales office and engineering department from 90 West Street, New York City, to the factory at Beacon, N. Y. The New York sales office will remain at 90 West Street, and Mr. Brinkerhoff will continue in charge.

The Esterline Company, Indianapolis, manufacturer of graphic recording instruments, announces the appointment of Walter W. Gaskill, 141 Milk street, Boston, as New England representative of the company.

The Bryant Electric Company, Bridgeport, Conn., announces the removal of its New York office to larger quarters in the Canadian Pacific Building, 342 Madison Avenue. George H. Williams will continue in charge.

The Black & Decker Manufacturing Company, Towson Heights, Baltimore, announces that its Atlanta branch office is now at 1508 Candler Building, where Thomas W. Peters, branch manager for the Southern territory, will make his headquarters.

The Diamond Electric Specialties Corporation, Newark, N. J., announces the removal of its Chicago office on May 4 to 43-45 South Wells Street. This change is made necessary owing to the need of additional space to take care of its increasing Western business and to permit carrying a greatly enlarged stock of Diamond flashlights and batteries.

The National X-Ray Reflector Company, Chicago, announces the appointment of Walter Hall as resident engineer for Indiana and southern Illinois, with offices at 305 Merchants' Bank Building, Indianapolis, Ind.

The Advance Electric Company, St. Louis, announces that it has completed arrangements for a sales agency and office with the Direct Equipment & Engineering Corporation, 50 Church Street, New York City.

The Black & Decker Manufacturing Company, Towson Heights, Baltimore, announces that its New York branch office, formerly at 141 Broadway, is now in the Printing Crafts Building, Eighth Avenue and Thirty-third Street. In order to co-operate more closely with its jobbers in this territory a service station has been established at the same address, where a complete stock of parts will be carried. C. R. Lundane is manager of the New York territory. The Detroit branch office has been removed from 19 Selden Avenue to 27 Watson Street. C. G. Odell is in charge of the Detroit district.

The National Wiring & Protective Company, 801 Flushing Avenue, Brooklyn, N. Y., has filed notice of increase in capital stock from $6,000 to $50,000.

The Thomas & Holben Electrical Repair Company, Allentown, Pa., recently incorporated, is planning to establish a plant at 1035 Hamilton Street for the repair of electrical equipment, armature rewinding, repairing machinery, etc. W. F. Holben is president.

The Baker R & L Company has removed its Cleveland office from the Leader-News Building to 2180 West Twenty-fifth Street.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A trading corporation in France (No. 34,-750) desires to secure an agency on commission for the sale of electrical and other industrial supplies.

An engineer in the Netherlands (No. 34,-751) desires to purchase a quantity of copper cable for double electric tram lines of about 60 kw., etc.

Foreign Trade Notes

ELECTRIC STEEL MILL FOR BRAZIL.—A decree authorizing the Federal Minister of Agriculture, Industry and Commerce to enter into a contract with the Brazilian Electric-Metallurgical Company for the construction of a steel mill equipped with electric furnaces was published in the *Official Gazette* of March 5, 1921. The importation of materials, such as machines, motors, furnaces, etc., will be free of duty for a period of thirty years, and permission is granted for the use of waterfalls belonging to the federal government.

USE OF INTERNAL-COMBUSTION ENGINES in BELGIUM.—According to advices from the American Consulate at Antwerp, there is a large use of internal-combustion engines in Belgium. The Diesel engines are used extensively for ship propulsion and sometimes for foundries and lighting purposes, most of the importations coming from Sweden, Germany and England. At the same time, there is a tendency toward the increase of electric drive for smaller plants.

WATER-POWER RESOURCES OF GREECE.—In a report to the Bureau of Commerce, William P. George, Vice-Consul at Athens, Greece, states that in 1917 the Greek government expropriated conditionally all rights connected with the use of water-power in the kingdom. A tentative estimate of the water-power resources of the country has placed the horsepower available at 497,500. The government, it is understood, is open to any reasonable offer by foreign capital to exploit these resources. Such capital will receive assistance from local banks or otherwise.

THE NATIONAL FOREIGN TRADE COUNCIL, 1 Hanover Square, New York City, has issued a pamphlet entitled "Commercial Possibilities of the Union of South Africa." This publication is a survey of the recent industrial expansion and the mineral and agricultural resources of a market presenting great possibilities for American enterprise. A copy may be obtained on request to O. K. Davis, secretary, 1 Hanover Square, New York City.

ELECTRIFICATION OF RAILWAY BETWEEN RIGA AND KEMMERN LATVIA, PROPOSED.—According to reports to the Bureau of Commerce, a group of foreign capitalists has begun negotiations with the Town Council of Riga Strand and the Ministry of Communications regarding the electrification of the railway between Riga and Kemmern (the seaside). It is proposed to utilize the present tracks and run storage-battery trains, the only equipment needed to be ordered from abroad. The Railway Administration contemplates equipping the Libau station and depots for electrical operation, energy to be obtained from the Libau naval port. The cost is estimated at 6,000,-000 German marks.

EXTENSION TO WATER-POWER DEVELOPMENT IN CATALONIAN PYRENEES.—The Sociedad Producora de Fuerzas Motrices, which was organized to develop the water power of the falls in the Catalonian Pyrenees in Spain to generate electricity on a large scale, according to the *Electrical Industries*, London, England, is issuing 10,000 7 per cent bonds of 500 pesetas each ($96.50 in United States money). The proceeds are to be used mainly for the extension of the works at Pobla de Segur Falls and the completion of those at the Cledes Falls.

NEW ELECTRIC PROJECT IN TAIWAN, CHINA.—Consul Dooman, Taihoku, Taiwan, China, reports that a company to be known as the Taiwan Electrical & Industrial Company, Ltd., is to be organized with a paid-up capital of 6,000,000 yen. The company proposes to supply energy from its hydro-electric plant at Giran to the Taiwan Electric Power Company, which has the sole right to distribute electricity for lamps and motors in Taiwan. Later it plans to undertake the production of cement, lumber, pulp and other commodities which would utilize electricity to operate the works.

New Apparatus and Publications

INDUSTRIAL TRACTOR.—The Elwell-Parker Electric Company, Cleveland, has a new electrically propelled tractor for the market.

PUMPS.—"Ten Years' Progress in Water Works Pumps" is a 100-page publication of the De Laval Steam Turbine Company, Trenton, N. J.

OUTDOOR SWITCHING. — "The Skeet Switch and Skeet Transformer Station," an eighteen-page publication, has been issued by T. J. Johnson, Jr., Electric and Gas Building, Atlanta, Ga.

BRITISH HANDBOOK. — "'The Electrician' Electrical Trades Directory and Handbook for 1921" has been published by Benn Brothers, Ltd., 8 Bouverie Street, London E. C. 4.

HYDRAULIC VALVES.—Bulletin No. 52 has been issued by the Wellman-Seaver-Morgan Company, Cleveland, entitled "The W-S-M Balanced Plunger Hydraulic Valve," a new product developed by the company.

STOKERS.—The Files Engineering Company, Inc., Providence, R. I., is distributing a sixteen-page booklet covering its hand-operated Files stokers.

ELECTRIC RANGE.—Landers, Frary & Clark, New Britain, Conn., has issued a four-page leaflet describing its new Universal electric range.

ELECTRIC FANS.—The Knapp Electric & Novelty Company, 511-513 West Fifty-first Street, New York City, is distributing a four-page leaflet describing its new "Limo-Sedan" fan.

STEAM TURBINES.—Bulletin No. 42,-201-B has been issued by the General Electric Company, Schenectady, N. Y., entitled "Curtis Steam Turbines" and describing these turbines of 100 kw. to 3,500 kw. capacity.

METERS.—Bulletin 55 of the Sangamo Electric Company, Springfield, Ill., describes new types of current and potential transformers for use with their alternating-current watt-hour meters and new developments in the company's rotating standard.

FURNACES. — The Electric Furnace Company, Alliance, Ohio, is distributing a seventy-page booklet of its Baily electric furnaces.

FITTINGS.—The Appleton Electric Company, 1701 Wellington Avenue, Chicago, has brought out a line of outlet-box covers with swivel fixture joints, a "Unilet" swivel fixture joint and a combination hickey and swivel fixture joint. A bulletin is in preparation.

THE BLEADON-DUNN COMPANY, Chicago, has issued a bulletin describing its newest product, a small-size violet-ray machine.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, is distributing price book No 52, applying to Emerson small motors, effective April 15. No price changes are listed, the book containing only revised data, latest-type designations and late information on stock types.

SOLENOIDS.—"C-H Iron-Clad Solenoids" is the title of a new leaflet being distributed by the Cutler-Hammer Manufacturing Company, Milwaukee, describing electric solenoids for operating breaks, etc.

BURN DRESSING. — The Industrial Products Company, Philadelphia, has recently placed on the market an instantaneous dressing for burns and scalds of all kinds.

SURGE ARRESTER.—The Electro Service Company, Marietta, Ga., is distributing bulletin No. 3-D, covering the Bennett surge arresters.

SUPERHEATERS. — The Superheater Company, 17 E. Forty-second Street, New York, is distributing bulletin No. T-7, entitled "Superheaters for Stationary Power Plants."

ELECTRICAL SUPPLIES. — The Wetmore-Savage Company, 76 Pearl Street, Boston, has just received its new 1921 general supply catalog of 1,500 pages for distribution to the trade in New England only.

MOTOR STARTERS. — The Allis-Chalmers Manufacturing Company, Milwaukee, has issued bulletin No. 1,114, entitled "Type 'R' Potential Starters for Squirrel-Cage Induction Motors."

BATTERY AND SERVICE STATION EQUIPMENT. — The H. B. Shontz Company, Inc., 161-167 West Sixty-fourth Street, New York City, factory distributer of supplies and equipment for storage-battery service stations and auto electrical repair men, is distributing its 1921 catalog, covering its battery and electrical service station supplies.

REFRIGERATION.—The Clothel Company, 61 Broadway, New York City, has issued a forty-eight-page booklet describing the "Clothel" system of mechanical refrigeration.

New Companies

THE J-E BATTERY & SUPPLY COMPANY, Pittsburgh, Pa., has been incorporated by J. W. Daniels, W. H. Virgin, D. A. Mahoney and Austin L. George, 1,110 Park Building, to manufacture storage batteries, etc.

LONDON MOTORS, LTD., London, Can., has been incorporated with a capital stock of $1,000,000 by Thomas H. Griffith, W. R. Stansell and T. A. Conley. The company proposes to manufacture motors, engines, etc.

THE GLOBE ELECTRICAL FIXTURE MANUFACTURING COMPANY, Newark, N. J., has been incorporated with a capital stock of $10,000 by Pemberton Dudley, Fred Wilson and William H. Freeman. The company proposes to manufacture electric fixtures and other electrical equipment.

THE JOHN A. STANDISH MANUFACTURING COMPANY, Bloomfield, N. J., has been incorporated by Charles J. Flessa, Edward Maguire and Howard I. Edge, 134 South Oxford Street, Brooklyn, N. Y. The company is capitalized at $5,000 and proposes to manufacture electrical equipment.

THE SUNSET FIXTURE COMPANY, New York, N. Y., has been incorporated by A. C. Mandel, J. J. Lazaroe and E. Goodman, 1480 Washington Avenue, Bronx. The company is capitalized at $20,000 and proposes to manufacture lighting fixtures and other electrical products.

THE BEDFORD LAMP WORKS, Brooklyn, N. Y., has been incorporated with a capital stock of $15,000 to manufacture incandescent electric lamps. The incorporators are S. E. Gertler, C. G. Katz and A. Adler, 411 Bedford Avenue.

THE NATIONAL ELECTRICAL CORPORATION, Whitman, Mass., has been incorporated by Harold B. Huntley, Harry G. Barnes and J. M. Hathaway. The company is capitalized at $5,000 and proposes to manufacture electrical equipment.

THE JAMAICA ELECTRIC SERVICE & EQUIPMENT CORPORATION, Jamaica, N. Y., has been incorporated with a capital stock of $10,000 by P. and P. J. and K. Guthy. The company proposes to manufacture electrical appliances and equipment.

GEORGE B. BANKS, INC., New Rochelle, N. Y., has been incorporated by F. G. Schrenkeisen and A. D. and G. B. Banks, 320 Fifth Avenue. The company is capitalized at $100,000 and proposes to manufacture electrical machinery.

THE AMERICAN LIGHTING & MANUFACTURING COMPANY, 800 Sibley Street, Chicago, Ill., has been incorporated with a capital stock of $100,000 by W. J. Davis, F. E. Davis and W. O. Turtle, 811 Sheridan Road. The company proposes to manufacture electric lighting equipment and appliances.

THE CARMEAN ELECTRIC COMPANY, Kansas City, Mo., has been incorporated to manufacture an electrical heater which can also be used as a ventilating fan. S. M. Carmean is president, W. H. Nance vice-president, Edward E. Naber secretary and H. P. Bowman treasurer.

THE SMITH ELECTRIC COMPANY, LTD., Sarnia, Ont., has been incorporated by Harry Smith, Leonard H. Darbyshire, Sarnia; Frank O. Smith, Petrolea, and others. The company is capitalized at $40,-000 and proposes to manufacture electrical machinery, equipment, etc.

Record of Electrical Patents

Notes on United States Patents

(Issued April 5, 1921)

1,373,928. REGULATOR FOR ELECTRIC GENERATORS; Fred H. Winter, Schenectady, N. Y. App. filed Sept. 11, 1918. Vibratory type.

1,373,931. RADIO RECEIVING SYSTEM; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed June 5, 1919. Continuous wave signals.

1,373,951. STORAGE-BATTERY INDICATING DEVICE; Clare C. Cox and George W. Lentz, Indianapolis, Ind. App. filed March 11, 1918. Graphic hydrometer.

1,374,003. RECLAIMING DRY BATTERIES; Carleton Ellis and Alfred A. Wells, Montclair, N. J. App. filed Sept. 29, 1917. Leclanché type.

1,374,041. SYSTEM OF ELECTRICAL DISTRIBUTION; William A. Turbayne, Niagara Falls, N. Y. App. filed Dec. 18, 1917. Lighting of railway cars.

1,374,042. SYSTEM OF ELECTRICAL DISTRIBUTION; William A. Turbayne, Niagara Falls, N. Y. App. filed Jan. 25, 1917. Car lighting.

1,374,043. SYSTEM OF ELECTRICAL DISTRIBUTION; William A. Turbayne, Niagara Falls, N. Y. App. filed Jan. 27, 1917. Lighting of railway cars.

1,374,047. TROLLEY POLE; Martin D. Watrous, Ansonia, Conn. App. filed Jan. 17, 1921. Trolley-wheel support free to rotate to limited extent.

1,374,076. PROCESS OF MAKING STORAGE-BATTERY PLATES; William H. Grimditch, Philadelphia, Pa. App. filed July 24, 1920. Positive plates of uniform composition.

1,374,080. ELECTRIC CURRENT GENERATOR FOR ARC CIRCUITS; Joseph A. Holifield, Mobile, Ala. App. filed Feb. 17, 1920. For electric welding and motion-picture machines.

1,374,091. DEVICE FOR HEATING BY ELECTRICITY; Antonangelo Negromanti, Milan, Italy. App. filed Oct. 4, 1920. Circulating fluid.

1,374,117. TROLLEY CONSTRUCTION FOR BARBERS' ELECTRICAL EQUIPMENT; Joseph A. Shelton, Henderson, Ky. App. filed Aug. 14, 1919. Current supplied to any chair.

1,374,119. PROCESS OF CATALYSIS; Elbridge W. Stevens, Baltimore, Md. App. filed March 18, 1920. Maintaining clean surfaces and effective catalytic action.

1,374,122. PROCESS FOR DYEING AND WATERPROOFING; Alfred O. Tate, New York, N. Y. App. filed April 20, 1920. Aniline dyeing.

1,374,123. PANELBOARD FITTING; George B. Thomas, Bridgeport, Conn. App. filed Dec. 12, 1917. Protective cover.

1,374,152. TELEGRAPH TRANSMITTER; Charles L. Krum and Howard L. Krum, Chicago, Ill. App. filed Nov. 29, 1909. Improved transmitter.

1,374,165. POTENTIAL-REGULATING SYSTEM; Harry L. Tanner, Brooklyn, N. Y. App. filed Nov. 2, 1915. Gyroscopic compass.

1,374,168. CORRUGATED DRY-BATTERY CUP; Adolph C. Recker, Oakville, Conn. App. filed Sept. 20, 1919.

1,374,170. GENERATING SYSTEM FOR ELECTRIC CURRENTS; August J. Kloneck, New York, N. Y. App. filed March 27, 1916. Oscillations of high frequency.

(Issued April 12, 1921)

1,374,171. ELECTRIC MOTOR; George W. Amann, Jr., Little Black, Wis. App. filed Dec. 21, 1917. Reciprocating.

1,374,179. TELEMOTOR; Melvin B. Benson, Superior, Wis. App. filed Dec. 27, 1916. Steering gear for vessels.

1,374,180. TELEMOTOR; Melvin B. Benson, Superior, Wis. App. filed Dec. 29, 1916. Steering gear for vessels.

1,374,184. TELEPHONE SYSTEM; Ernest C. Britton, New York, N. Y. App. filed July 9, 1917. Machine switching.

1,374,188. TELEPHONE SYSTEM; Henry P. Clausen, Mount Vernon, N. Y. App. filed May 11, 1918. Trunk-line circuits.

1,374,192. SELECTIVE SYSTEM; Almos F. Dixon, Newark, N. J. App. filed July 2, 1917. Printing telegraphy.

1,374,201. SELECTOR; John A. Hall, Bayside, N. Y. App. filed Sept. 19, 1919. Automatic telephone.

1,374,202. HEATING UNIT FOR WASHING MACHINES; Irvin H. Harris, Evanston, Wyoming. App. filed Jan. 14, 1920.

1,374,219. COMPOSITE TRANSMISSION SYSTEM; Harold S. Osborne, New York, N. Y. App. filed Feb. 12, 1919. Telephone and telegraph signals over same conductors.

1,374,220. COMPOSITE SIGNALING SYSTEM; Harold S. Osborne, New York, N. Y. App. filed Feb. 12, 1919. Telephone and telegraph communication over same conductors.

1,374,221. COMPOSITE PHANTOM CIRCUITS; Harold S. Osborne, New York, N. Y. App. filed Feb. 12, 1919. Telephone and telegraphic communication over same conductors.

1,374,230. TEMPERATURE CONTROLLER; Fred J. Petrovics, Chicago, Ill. App. filed July 17, 1920. For sadirons, curling irons, etc.

1,374,235. X-RAY PHOTOGRAPHING APPLIANCE; Gordon E. Richards, Toronto, Ontario, Canada. App. filed June 20, 1919.

1,374,237. ELECTRIC GAS GENERATOR; Rudolf Rosner, Chicago, Ill. App. filed June 17, 1920. For killing germs.

1,374,241. RHEOSTAT; William Schwagermann, Yonkers, N. Y. App. filed June 27, 1917. Dial type.

1,374,266. GENERATING SYSTEM; Charles White, East Orange, N. J. App. filed Oct. 23, 1918. Telephone system.

1,374,285. ELECTRIC REGULATOR; Rhys Davies, Fort Wayne, Ind. App. filed May 9, 1919. Socket rheostat.

1,374,293. WIRELESS DIRECTION FINDER; Reginald A. Fessenden, Chestnut Hill, Mass. App. filed July 28, 1919.

1,374,317. PROCESS AND APPARATUS FOR THE MANUFACTURE OF CARBIDES AND DERIVATIVES THEREOF; Fred E. Norton, Worcester, Mass. App. filed April 1, 1918. Electric furnace.

1,374,332. RHEOSTAT; Clarence C. Stirling, Hartford, Conn. App. filed Jan. 14, 1920. Compression.

1,374,366. TELEPHONE SWITCH; George W. Dickerson, Galion, Ohio. App. filed June 26, 1916. Telephone exchange.

1,374,381. CONNECTING RAILS; John C. H. Lubken, Westmont Borough, Pa. App. filed Dec. 12, 1919. Bonding.

1,734,404. AUTOMATIC ARC REGULATOR; James E. Soons, New York, N. Y. App. filed Nov. 15, 1919. Will maintain uniform length of arc.

1,374,411. FLASHLIGHT; George V. C. Vreeland, East Orange, N. J. App. filed Nov. 22, 1919. Switch mechanism.

1,374,414. ELECTROMEDICAL BRUSH; Henry Weiss, New York, N. Y. App. filed July 25, 1919.

1,374,453. ELECTRIC RIVET HEATER; Frederick T. Kitt, Seattle, Wash. App. filed Aug. 26, 1919. Jaws receive rivets of different lengths.

1,374,477. STORAGE-BATTERY PLATE OR ELECTRODE; Edward W. Smith, Philadelphia, Pa. App. filed Sept. 4, 1918. Metallic rods surrounded by active material.

1,374,521. SYSTEM OF CONTROL; Laurence M. Perkins, Swissvale, Pa. App. filed Nov. 16, 1917. Single-phase commutator machines.

1,374,529. CONNECTOR PLUG; Frank L. Simmons, Woonsocket, R. I. App. filed Feb. 1, 1918. For use with magnetic chucks.

1,374,534. CIRCUIT-INTERRUPTING DEVICE; Norman W. Storer, Pittsburgh, Pa. App. filed Jan. 6, 1917. No movable parts.

1,374,535. SYSTEM OF CONTROL; Norman W. Storer, Pittsburgh, Pa. App. filed Sept. 28, 1917. High-voltage railway.

1,374,537. STRUCTURE FOR TROLLEY-WIRE FITTINGS; Nils J. A. Wahlberg, Pittsburgh, Pa. App. filed Aug. 7, 1917. Splicers, frogs, strain supporters, etc.

1,374,541. ELECTROLYTIC PROCESS; Frederick S. Woodward, Richmond Hill, N. Y. App. filed July 25, 1919. Copper deposition.

1,374,557. ARC-WELDING SYSTEM; Otto H. Eschholz, Wilkinsburg, Pa. App. filed Feb. 15, 1919. Alternating current.

1,374,558. ELECTRIC RANGE; Frank F. Forshee, Flint, Mich. App. filed Sept. 25, 1919. Thermostat mounted in oven door.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

Middle Atlantic States

ALBANY, N. Y.—Plans have been prepared for the construction of a one-story power house at the local works of Swetzer & Bainbridge, Inc., Tivoli Street.

BATAVIA, N. Y.—Plans are under way for the extension of the lines of the Genesee Light & Power Company to furnish electrical service in Alexander and Pembroke.

BROOKLYN, N. Y.—The Brooklyn Edison Company has been authorized to issue $750,000 in bonds for the construction of a generating plant on Marshall Street near the Brooklyn Navy Yard.

LITTLE FALLS, N. Y.—The installation of an ornamental lighting system on part of Main Street is under consideration.

GLOUCESTER, N. J.—Plans are under way for the reconstruction of the municipal waterworks system at a cost of about $170,000. Plans provide for the installation of electrically operated equipment, including two high-pressure-type pumps and two of low pressure, and the construction of a filtration plant.

SEA ISLE CITY, N. J.—The Board of Public Utility Commissioners has approved the sale of the plant of the Electric Light & Power Company of Sea Isle City to the municipality for $67,000.

TRENTON, N. J.—All bids received for lighting Upper Stacy Park have been rejected by the City Commission, and new bids will be asked. Commissioner Fell is in charge.

HAZLETON, PA. — The Pennsylvania Power & Light Company, Allentown, plans to extend its lines to connect with the system of the Lehigh Traction Company with which it has an agreement to supply power. Service will be furnished from the Harwood plant.

MIDDLEBURG, PA. — The Middleburg Light, Heat & Power Company has filed notice of $40,000 increase in its capital stock.

PHILADELPHIA, PA.—The Department of Public Works is having plans prepared for the construction of a switchboard department and motor building at Lycoming and O Streets.

HUNTINGTON, W. VA.—Arrangements are being made by the Consolidated Light, Heat & Power Company for an increase in its capital stock from $530,000 to $865,000 to provide for proposed extensions, improvements, etc. W. W. Perkins is secretary.

BUCHANAN, VA.—The Buchanan Light & Water Company contemplates the construction of a steam power plant, 38 ft. x 75 ft., including a flight conveyor-type coal hoist, installation of a 1,200-hp. boiler, etc. L. Hudson, Wabash Building, Pittsburgh, Pa., is engineer.

EDINBORO, VA.—Plans are under way for the construction of a power house to cost about $50,000, at the State Normal School. Cody, Hicks & Davidson, Ariol Building, Erie, Pa., are architects and engineers.

HALIFAX, VA.—Work is under way on the construction of a hydro-electric plant on the Bannister River by the Halifax Power Company, to develop 1,350 hp. for service in Halifax and South Boston. Present plans provide for an increase of from 8-ft. head of water to 25-ft. The cost of the work is estimated at $350,000. W. C. Whitney & Company, Richmond, are consulting engineers and contractors.

North Central States

HOLLAND, MICH.—The installation of ornamental lamps is under consideration by merchants on Eighth and River Streets.

LANSING, MICH.—Plans are being prepared for the proposed new municipal electrical plant, 150 ft. x 245 ft., to cost about $500,000. The initial installation will pro-

vide for about 55,000 kw. Woodwell & Resler, 501 Fifth Avenue, New York City, are engineers.

BOWLING GREEN, OHIO.—The installation of a cluster lighting system in Bowling Green has been recommended to the Council by the Kiwanis Club.

CINCINNATI, OHIO. — The Cincinnati Traction Company has applied to William C. Culkins, director of street railways, for approval of an expenditure of $380,000, preparatory to purchasing energy from the Union Gas & Electric Company. The plans include the equipment of seven transformer stations in different parts of the city. Three of the stations will work automatically. The contract for the purchase of power goes into effect in September.

GALION, OHIO.—Improvements to the municipal electric light plant are contemplated.

LOUISVILLE, KY. — Plans are under consideration by the Louisville Gas & Electric Company for the construction of another power plant at the waterside station, to cost between $2,500,000 and $3,000,000.

SULLIVAN, IND.—The Community Club has appointed a committee to confer with the Wabash Electric Company regarding improvements to the lighting service in Sullivan. It is proposed to replace the arc lamps now in use with modern lamps and install cluster lamps in the business section of the city.

JACKSON, MINN.—The question of issuing $13,500 in bonds for the installation of an ornamental lighting system in Jackson is under consideration.

DENISON, IOWA.—The citizens of Dow City and Arion have petitioned the Council to extend the municipal electric lighting service to those towns.

DELPHOS, KAN.—Bonds to the amount of $30,000 have been voted for municipal lighting purposes.

ELLINWOOD, KAN. — Bonds to the amount of $40,000 have been voted for improvements to the municipal light and water plant.

Southern States

AHOSKIE, N. C.—The Council is considering an issue of $40,000 of electric light and water bonds.

CORNELIUS, N. C.—Arrangements are being made for an issue of electric light bonds to the amount of $10,000.

RANDLEMAN, N. C.—Arrangements are being made by the Council for an issue of bonds for the purchase of the plant of the Randolph Power Company. Extensions and improvements are contemplated.

MARIANNA, FLA.—G. M. Thomas contemplates the construction of a hydro-electric plant to develop 200-hp. The plans provide for the erection of transmission lines, installation of generators and waterwheels. The Albany Electro Company, Albany, Ga., is engineer.

SAFETY HARBOR, FLA.—The Borough Council is considering an issue of $10,000 in bonds for an electric lighting plant.

SEBRING, FLA.—Bonds to the amount of $250,000 have been voted for improvements to the electric light plant and waterworks, etc.

BIRMINGHAM, ALA.—The board of directors of the Civic Association has adopted resolutions approving the installation of an ornamental lighting system on Fifth Avenue.

BELZONI, MISS.—At an election to be held in May the proposal to issue $25,000 in bonds for improvements to the municipal light and water plant will be submitted to the voters.

BILLINGS, OKLA.—Contract has been let to the Oklahoma Gas & Electric Company to furnish electricity for lamps and motors in Billings.

CHEROKEE, OKLA.—Bonds have been voted for the construction of a transmission line from the municipal electric plant in Cherokee to supply electricity to the towns of Jet and Nash.

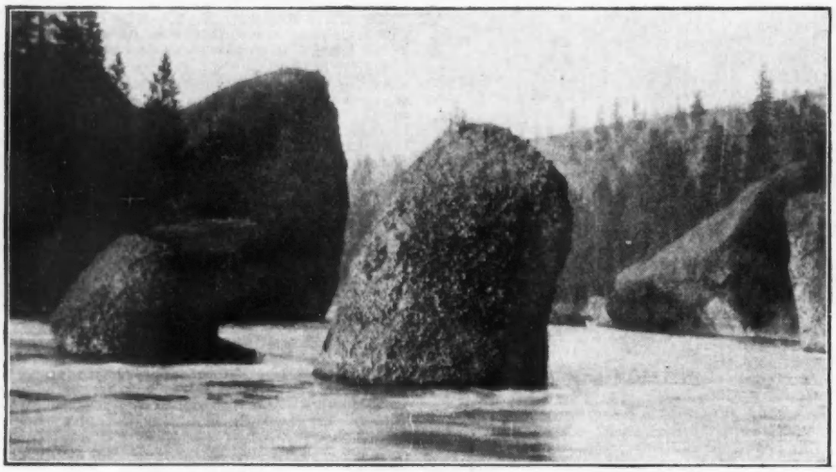
LAWTON, OKLA.—The Lawton Railway & Lighting Company contemplates extending its line from Fort Sill to Medicine Park, a distance of 9 miles. The cost is estimated at $300,000.

PADEN, OKLA.—Bonds to the amount of $8,200 have been voted for improvements to the electric light plant.

YALE, OKLA.—Plans are under way for the installation of an ornamental lighting system in Yale.

SAN ANGELO, TEX.—The San Angelo Water, Light & Power Company plans to double the output of its plant, including the installation of a 500-hp. engine and generator, to cost about $70,000. The company also plans to construct a transmission line to the State Tuberculosis Sanitarium and into Concho and Colorado River Valleys to supply electricity to operate irrigation pumps.

EDINBURG, TEX.—The City Commissioners have voted to submit to the people a proposal to issue $100,000 in bonds for electric lamps, improvements to waterworks, etc.



THE BOWL AND PITCHER RAPIDS, THREE MILES BELOW SPOKANE

Eight years ago the Spokane Valley Power Company was organized and obtained the necessary rights and areas for dam and building site at this point, together with the lands covered by the overflow. Plans have since been prepared for a 65-ft. dam. A lake 3 miles long will be formed, and as this will cover a section of the area comprising Fort George Wright it was necessary to have federal legislative permission. This has now been accomplished, and it is expected that a definite move toward the erection of the power plant will be taken shortly. The accompanying view of the rapids has not hitherto been published.

Pacific and Mountain States

PULLMAN, WASH. — Bids will be received soon, it is understood, for the installation of a new boiler and generators for the heating system of the new gymnasium at the Washington State College.

SPOKANE, WASH.—Investigation of the power possibilities of Kettle Falls on the Columbia River in Stevens County, 72 miles north of Spokane, is being made by the Washington Water Power Company with a view to purchasing a power site.

SPOKANE, WASH.—A contract has been let by the Chelan Falls Power Company for the construction of a 30-ft. dam across the Chelan River at its narrowest point for $40,000. The plans provide for an initial installation of 1,250 hp.

TACOMA, WASH.—Preliminary investigations have been started, of the rock gorge at the Lake Cushman power site, where the city proposes to locate the great impounding dam of the project.

TACOMA, WASH.—Investigation is being made of the possibility of supplying electricity to residents of Spanaway, Brookdale and vicinity. Ira S. Davisson is commissioner of the light department.

VANCOUVER, WASH.—The City Council has granted the Northwestern Electric Company a fifty-year franchise to install and operate a distribution system in Vancouver and surrounding territory. The company is now installing an 11,000-volt, three-phase cable on the S. P. & S. Railroad bridge, which will tap one of the overhead distribution lines of its Portland system. The transmission line from the company's hydro-electric plant on the White Salmon River will be extended from Camas to Vancouver to tie in with the new system there. A distribution system will be installed as soon as possible within the city.

WENATCHEE, WASH. — Norwood W. Brockett of Seattle has applied for a franchise to erect electric power lines in Wenatchee and over all roads of Chelan County.

LOS ANGELES, CAL.—Application has been made by the Green River Power Company, Pacific Electric Building, to the Federal Power Commission for a preliminary permit to develop all the water power in Green River from a point near Green River, Wyo., to its junction with Grand River in Utah, for public utility purposes.

LOS GATOS, CAL.—The installation of a new lighting system in Los Gatos is under consideration.

SAN FRANCISCO, CAL.—Roy C. Hackley has applied to the State Water Commission for 500 cu.ft. per second direct diversion, 50,000 acre-ft. per annum for storage from Middle Fork of Feather River, tributary to Feather River, Butte County, for power purposes. The plans provide for the development of about 23,984 hp. Diversion will be made by means of a concrete dam. The cost is estimated at $1,500,000.

VENICE, CAL. — The Pacific Electric Railway Company, Los Angeles, is considering the construction of a subway or elevated railway through Venice, Ocean Park and Santa Monica.

LOGAN, UTAH.—The City Commission is considering the advisability of installing meters to replace the present flat-rate system.

PANGUITCH, UTAH.—The city officials are considering the purchase of the 100-hp. plant of the Telluride Power Company on Panguitch Creek, from which the municipality is supplied with electrical service.

PAYSON, UTAH. — The City Council is considering the extension of the municipal lighting system to Spring Lake. Electrical service is also being sought by other suburban sections of Payson.

SALT LAKE CITY, UTAH.—The Utah Copper Company contemplates the construction of an electric generating plant to supply electricity for its local properties. The initial installation will have a capacity of 55,000 kw.

GRANGEVILLE, IDAHO. — Application has been made to the Federal Power Commission by the Grangeville Electric Light & Power Company for license to construct a dam, conduit and power house in the south fork of the Clearwater River for public utility purposes.

IDAHO FALLS, IDAHO.—Contract has been awarded to the Wellman, Seaver & Morgan Company, Cleveland, for two 500-kw. generating units for the municipal electric plant, at $34,950.

Canada

ST. JOHN, N. B.—The New Brunswick Electric Power Commission, it is reported, will receive new bids for the construction of the power house in connection with the Mushquash development.